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ACTIVITY IN ELECTRICAL PRODUCTION.

Elsewhere in this issue will be found the annual report of the General Electric Company, to which attention may be directed on account of its value as an exhibit of the activity pervading all spheres of electrical production. In view of the depression which prevailed during the first half of 1904, when every branch of manufacturing and industrial enterprise was depressed, it is remarkable that the second half of the year should have restored conditions so nearly to the normal that, as a matter of fact, the results for 1904 were almost on a par with those of 1903, which was in some respects an abnormal year. The value of the production appears to have been about $2,500,000 less than in the preceding year, but if quantities could be compared it would probably be found that the two years are very closely on a parity.

The report bears interesting testimony to the activity in all the fields of work in which the company finds employment, and particularly that of electric railways. There is no reason to believe that opportunities in this field will grow less. On the contrary, they increase from moment to moment and the work during the next two weeks of the International Railway Congress in Washington will but exemplify the extent of the new duties that are about to be laid upon all electrical manufacturers and electrical engineers in the steam railway field. The prosperity of the General Electric Company may be regarded as typical of that which in general has been enjoyed by electrical industries, and the company is once more to be congratulated upon the clearness and fullness with which it makes its exhibit to the public. In this way the respect of the community is gained and held, for the time is rapidly going by when the affairs of industrial corporations can be clothed in mystery.

EXPIRATION OF THE TESLA FUNDAMENTAL POLYPHASE PATENTS.

The expiration this week of the three Tesla patents covering fundamentally the rotary-field type of electric motor marks the close of the first stage of one of the several epochal developments of the modern electrical era. It would be interesting to review the great rôle that the invention covered by these patents has played in electrical engineering and in industrial electrical progress, but what is probably at present uppermost in the minds of all interested directly in this branch, is the effect of the expiration of the 1888 Tesla patents toward opening up to the world at large a department of the industry which, for seventeen years, has been a monopoly under the Federal constitutional provision that so wisely grants this privilege as a reward for the labors of the inventor, and to encourage others through invention to add to the wealth and to the well-being of the country. As in the case of the termination of other close patent monopolies, there is unfortunately no clear understanding at the present moment as to the actual situation developed by the expiration of the 1888 Tesla patents. The litigation of the past has had relation only to two sets of polyphase patents—those just expired and the 1893 Tesla split-phase group—and little or no specific information is obtainable in regard to the situation now presented, even from those who have taken an active part in this litigation. To complicate the matter still further, it is announced by the owners of the patents just expired that more than a score of other patents relating to polyphase motors and polyphase operation are yet active, the inference being that it is by no means conceded that the polyphase

art is opened wide by the expiration this week of the three 1888 Tesla patents.

Of the three patents which have just expired, the first has been defined by the courts as covering the apparatus by which the polyphase system is put in practice; the second as covering the electrical transmission of power by the method of operation described in the first patent, which patent also covers a different construction of motor; and the third as covering a specific construction of motor embodying the invention of the other two patents. In considering these three patents, the courts in various decisions have held them, broadly, to cover the system of producing power from an electric motor by means of a rotary field. It is, therefore, reasonable to assume that the expiration of these three patents releases to the world the principle of the rotary field. As to the split-phase patents, the consideration of their validity was so bound up with the rotary-field principle that their affirmation by the courts is now subject to challenge, which doubtless will be offered. While the rotary-field principle was invariably sustained in all litigation, the invention by Tesla of the split-field principle was denied by two courts of first instance, one of which was sustained on appeal and the other reversed.

Naturally, during the seventeen years' life of the patents just terminated, many subsidiary patents have been issued, which latter, owing to the coutrolling issue of the rotary field, have not figured in litigation or, at least have not been subject to interpretation by courts. To what extent this line of patents may narrow the effect of the termination of the life of the fundamental patents is a matter for judgment by those intimately interested, or for determination ultimately by the courts. If litigation with respect to these subsidiary and detail patents should ensue, it is to be hoped that during its course some principle may be established making a clear distinction between invention proper and improvement merely incident to the normal development of a basic invention. The criterion which the courts have in the past so freely applied—that lack of prior conception is a presumption in favor of real invention—is certainly of doubtful value when applied to an art closed to the world during its period of development.

HIGH TENSION INSULATORS.

From recent tendencies in insulator construction we are disposed to believe that there is beginning to be a proper appreciation of the paramount importance of quality in the material. For a time it seemed as though quantity was the thing, but the bathtub style now seems to be passing away and the value of skilled design becomes more evident. So long as voltages seldom ranged above 20,000, insulators were easy and the particular shape chosen was merely a matter of individual taste. Now high-tension lines are working above 50,000 volts and the cry is constantly for more. But as the voltage rises there is great danger of trespassing upon the factor of safety of the insulators, and that to a dangerous degree. Taking porcelain insulators as they are made, the factor of safety in the various forms generally runs from 2.25 to 3, assuming the factor of safety to be the ratio between the guaranteed test voltage and the rated line voltage. This is, of course, before the insulators have been in service and exposed to the effects of prolonged electrical strains and of weathering. Under the test voltage a certain small proportion of the insulators break down, and those that do not are assumed to be sound. Has anybody ever taken down a group of insulators used for, say, a year on high-voltage work and tested them again under the same conditions as at first? If so, was the factor of safety found to be unimpaired? Here is a subject of vital importance to high-voltage transmission work which has certainly never been properly investigated, if at all.

Glass is known to weather to a certain extent. The changes probably do not affect the dielectric strength materially, but they may lead to decreased power of resisting the tendency to "spill over" and also may lead to the development of flaws. Porcelain is, if properly glazed, more resistant to the weather, but is all insulator porcelain properly glazed, and if the glaze be penetrated what is the body of the insulator worth? So long as insulators or insulator parts were of moderate dimensions, they could be baked at a temperature high enough to insure pretty thorough vitrification of the body material, but in the very big insulators this is increasingly difficult, and there has been a tendency to rely too much on a glaze which may be permanent or may tend to chip and weather. For this reason a good many engineers like glass, as being homogeneous and showing flaws easily, although not always trustworthy if put up untested. In fairly dry climates glass has done admirably even at very high voltage, but how it stands in bad climates is not so certain. In short, it is desirable to know something about the actual life of high-tension insulators, and especially with reference to the maintenance of the orignal factor of safety. An insulator must resist successfully mechanical strains, electrical strains and electrical surface leakage. In view of the experience of the past few years, it is possible to design insulators so as to stand a given voltage, provided that the surface does not alter or get loaded with a semi-conducting film of dirt. With respect to this last qualification, the shape must be such as to be easily cleanable, and it is imperative that the surface should be so resistant that an adherent dirt film will not readily form. The general opinion seems to be that porcelain meets these requirements better than glass.

Nevertheless, we must confess to a liking for glass if the right thing can be obtained. Glass, like porcelain, is a very general term, and various glasses differ in nothing more than in their power of resisting electrical leakage. Manufacturers of electrostatic apparatus know to their sorrow the difficulty of getting glass of proper quality, and, although an enormous amount of energy has been spent in making glass for optical and other purposes, glass for electrical purposes has not yet been made the subject of sufficient study. Our American makers turn out some very creditable glass insulators for pressures even up to 40,000 volts or more, but there is good reason to believe that much more can be done with glass than has yet been attempted. A glass insulator is sure of possessing good insulating properties all the way through, is easy to inspect and to examine for adherent dirt. Its weak point is weathering and moderate mechanical strength. Glass, however, differs very greatly both in surface solubility and in strength, and we are inclined to think that if our glass-makers took up the matter thoroughly they could turn out an insulator as good or better than a porcelain one for the very highest voltages. Certainly the famous Jena glass works, while not at all in the insulator business, do produce some glasses which have electrical properties far ahead of any usually to be found, and glasses, too, wonderfully free from tendency toward surface disintegration, and exceptionally strong.

If the pressures of transmission circuits continue to increase, there is necessity for very considerable work upon insulators. It is one thing to turn out a good insulator for 50,000 volts and quite another to produce a good one for 100,000 volts, maintaining a decent factor of safety. The highest possible grade of material must be found and worked into the best possible form if working pressures are to keep on rising. We are not in the least censuring our insulator makers, who really turn out an admirable product, but we merely want to impress them with the fact that high-voltage transmission is up to them and that the best thing possible should be evolved.

OSCILLOGRAPHS AND ONDOGRAPHS.

In view of the continually increasing importance of alternating currents in electrotechnics, interest in apparatus for revealing, recording and analyzing wave forms of pressure and current steadily increases. Not only does the wave form of pressure on an alternating-current circuit vary with the details of the generator structure, but it also varies with the magnitude and character of the load. It has also been shown that an extensive system of alternating-current power transmission lines is like an ocean, on the surface of which waves are perpetually traveling, rising and falling, the resultant wave form of current or pressure at one place in the system being different to an appreciable extent from that at a distant place, both in contour and in phase. The apparatus for determining the wave form differs considerably in type, according to the particular purposes in view. In the physical laboratory the apparatus has to yield observations of considerable precision and reliability, under conditions that are definite and reproducible. In the engineering laboratory a lesser degree of precision will serve, but a greater degree of convenience and of pliability to varying conditions is desirable, since all kinds of circuits may call for investigation. In the factory testing room still other requirements have to be met. Consequently, it is not likely that one and the same form of instrument should come into use in all of these places.

We print on page 839 an article upon a particular form of oscillograph which has been developed in the Massachusetts Institute of Technology to meet the requirements of students in their laboratory. The details of the apparatus are interesting with respect to ease of manipulation and simplicity of repair. Nothing is more annoying than weeks of delay in the progress of an alternating-current research because an oscillograph suspension has broken and it is necessary to send it to the maker for repair. When the suspension is so simple that it can be renewed in the laboratory workshop without difficulty, the advantage is very great. At the last meeting of the American Institute of Electrical Engineers a paper was read upon the subject of "The Oscillograph and Its Uses," by Mr. L. T. Robinson. In this paper the history of the development of such instruments is outlined. Two types of apparatus are considered by Mr. Robinson. In one of these a record may be made photographically of a single wave. This is the oscillograph type. In the other a record may be made of a wave form from a relatively large number of similar successive waves. This is the ondograph type. There is also an intermediate form of instrument, called the wavemeter, which enables a photograph to be made from a relatively small number of successive waves.

Referring to the oscillographs, the priority in the publication of these is given to Blondel, who has devised two classes of them. In one of these there is an iron ribbon tightly stretched between the pole tips of a powerful magnet and carrying a small mirror. The rate of vibration of this iron strip may be ten thousand or more periods per second. Consequently, it is unlikely to resonate to any frequency presented by an alternating-current wave of the usual frequency between 25 and 60 cycles per second. By immersing the strip in oil, its oscillations are also damped so as to be aperiodic. That is to say, a single vibratory blow or impulse given to the strip will cause it to give a sudden twist or deviation, and then to return steadily to its original zero without overshooting the same. Under these conditions all the fluctuations of any importance in the contour of an alternating-current wave, passing through a magnetizing coil close to the strip, will effect corresponding angular deviations of the same capable of being recorded photographically by a beam of light reflected from the mirror. It is possible also, by suitable means, to render visible the wave of current being investigated. This property of the oscillograph is especially advantageous for facilitating the determination of the effect of changes in circuits subjected to recurring waves of current.

In the second, or vibrating-strip, type of Blondel oscillograph, which has received development from Duddell, the iron ribbon is replaced by a stretched loop of fine wire, forming a D'Arsonval coil of one turn and carrying a mirror near the middle of the loop's length. The alternating current under test passes around the loop and causes the same to deflect in a powerful magnetic field. A sufficiently high frequency of natural oscillation can also be given to this strip and the damping to aperiodic motion is effected by oil immersion as before. The Duddell oscillograph usually employs two such strips side by side, one, say, for recording voltage waves, and the other for current waves. This makes a most interesting combination, revealing the relative phase displacement of voltage and current. In the ondograph type a commutator is arranged to make contact at a particular point of each wave, and this point can be steadily advanced along the wave as fast as the readings are recorded. In the Hospitalier instrument the readings are automatically recorded in ink on the surface of a slowly moving drum, so that the complete wave is traced out in 1,000 cycles, or in 40 seconds at 25-cycle frequency. In the Rosa curve tracer the record is made by the observer pressing the pen on the drum, as soon as he obtains a potentiometer balance at the point of the wave under examination. This enables great precision to be obtained, with a corresponding delay in completing the cycle. The greatest objection which can be urged against this type of wave indicator resides in the fact that it can be used with perfect results only when the generator is directly at hand. Its chief characteristic is the high degree of accuracy which can be obtained when the conditions are favorable for its use.

Mr. Robinson ends with a description of a particular form of oscillograph developed recently, possessing special advantages for engineering laboratories. In this instrument there are no less than three independent oscillograph vibrator strips side by side, each in its own electromagnetic field, so that three waves may be photographed simultaneously on the same film. An arc lamp set up beside the instrument sends a beam of light to the mirror on each strip and thence to the photographic film, or to the eye of the observer. A few records made by the instrument are appended to the paper. One of these shows the voltage waves of an alternator as applied to a condenser and also to a reactance. The current in the condenser path and also the current in the reactance path are shown on the record. The impressed voltage is peaked, having a neck and two symmetrical shoulders like a man minus his head. The current in the non-ferric reactance is nearly a smooth sine wave lagging 75° behind the impressed voltage, while the condenser current follows a most erratic plunging path with about two dozen sharp peaks in it. It is difficult to realize that this erratic path is a wave form advanced nearly 90° ahead of the impressed voltage wave. This record is most instructive and is worth much study. It shows at a glance that while a non-ferric reactance tends to smooth out the kinks in a current wave, a condenser tends to exaggerate them. The reactance wave is, in fact, nearly the integral of the voltage curve from a mathematical standpoint, while the condenser wave is the first differential of the same. Or, expressed in another way, the condenser current wave is approximately the second differential curve of the reactance current wave. If only two successive differentiations produce such fireworks from a nearly smooth curve, it is terrible to think of what the *n*th differential curve would be like.

Tesla and the Polyphase Patents.

By B. A. Behrend.

In May, 1888, were granted to Nikola Tesla, from Smiljan Lika, border country of Austria-Hungary, a series of patents, which are commonly known as the fundamental Tesla patents. These patents expired on the 4th of May, 1905.

The genius of Tesla has been instrumental in stimulating, if not in creating, a wonderful industry—wonderful in magnitude, and wonderful in the ingenuity of the apparatus used in the accomplishing of the transmission of power over long distances.

Great ideas are rarely the exclusive property of individual men. The history of the evolution of thought shows distinctly that novel ideas arise in certain generations simultaneously in the minds of some of the most talented men whose personalities, as it were, thus represent the ideas and lend them their names; and so it has undoubtedly been with the ideas and inventions that form the basis of the polyphase system. The official sanction of the Patent Office, depending as it does as much upon the technicalities observed in wording the claims as upon the character and ingenuity of the invention itself, can hardly be taken as a criterion of the originality of the inventor. The function of the Patent Office is rather to be compared with the function assumed by the courts in recording deeds of property than as a scientific court passing upon the inventor's work. The paramount importance of the Patent Office lies in the fact that, as no property can be rightfully owned without a deed therefor, no man can use his ideas and inventions without obtaining a deed, which deed we call a letters patent. You may use your ideas without such letters patent only to find that some one else, by applying for and securing such patent after you have put out your invention, has secured the deed from the Patent Office.

But we are not concerned here with the philosophy of patent law and the existing conditions—we want to pay a tribute to Nikola Tesla, the ingenious inventor who, by a "sort of glorified common sense and unfailing intuition, picked his way through puzzling mazes of complicated phenomena, and protected himself from the pitfalls and the alluring by paths ensnaring smaller intellects." With Nikola Tesla, in this country and in Europe, worked a host of capable and ingenious engineers, and their work, vivified by the ingenuity of Tesla's inventions, has become one of the greatest monuments of engineering achievement crowning the work of the nineteenth century. Let us turn our attention for a moment to Tesla's remarkable paper, entitled "A New System of Alternate-Current Motors and Transformers," read at the meeting of the American Institute of Electrical Engineers, in New York, on May 16, 1888. This paper, even when considered in the light of subsequent discoveries and knowledge, is one of the most brilliant pieces of engineering thought, teeming with suggestions and ideas, animated with an intuition of the highest order, and giving an exposition of the working of the induction motor in a manner which resembles the methods pursued in the "Experimental Researches on Electricity," of the great master, Michael Faraday.

For seventeen years, the Tesla patents have formed the nucleus of the electrical industry. Through plenty of litigation and decisions they have survived, as all things survive the struggles of this world, only to expire, and it must be said that the expiration of these patents is looked upon in general as a very happy event. We do not wish to say that the monopoly which these patents created has been abused; we do not wish to say that the progress in this field has not been as vigorous as it would have been had the patents not been quite so sweeping; the field is so wide and the desire for vigorous competition so strong, that the expiration of these patents will give the electrical industry a new stimulus, and it must be borne in mind that, after all, these patents do not represent the only valuable ideas on the subject of polyphase alternating-current systems. Many are the inventions and ideas which have been originated by others, and which have made the polyphase system practicable. We all know how great is the difference between mere ideas, which are as plentiful as blackberries, and the working out of these ideas into practical form, which often requires the expenditure of as much genius as was required for the evolution of the idea itself. Ideas appear to me to be somewhat like what Darwin called "variations,'" from which, by a process of selection, *those* ideas are singled out which can hold their own, and are developed into practical form, while the greater number of ideas are cast aside, unfit, condemned to be destroyed in the struggle for existence.

Nikola Tesla and his patents have had their day; the art of electrical engineering, the capital invested therein, the users of polyphase electrical machinery, all are grateful to Nikola Tesla and to those who have developed his ideas.

The Expiration of the Tesla Patents.

By William Stanley.

In 1885 Prof. Galileo Ferraris, of Turin, discovered the electromagnetic rotating field, and applied his invention to the operation of a rotating field motor. On May 1, 1888, Mr. Nikola Tesla received United States patents covering the broad application of the Ferraris discovery of alternating-current motors. In 1888 Mr. George Westinghouse purchased the Tesla patents and contracted with Prof. Ferraris to exploit his inventions in this country, paying to the great Italian savant the munificent sum of 5,000 lire—$1.000—for such right. The Ferraris applications for United States patents were then entrusted to the Westinghouse (Tesla) attorneys, and having promptly died in the patent office, were followed by new applications drawn in the name of Mr. Tesla. These later applications exactly described the original (1885) discovery of Ferraris, the United States rights to which had been purchased by Mr. Westinghouse, as stated above. As a result of these various moves we have the original (1885) Ferraris split-phase motor patented by Tesla in 1890, and still in force, and the subsequent 1888 patents by Tesla, now expired.

The advent of the rotary field motor patents in 1888 was of great importance to the art, for while these patents did not disclose means for constructing commercial alternating-current motors, yet they threw a strong light on the art, illuminating its future. The expiring Tesla patents were usefully drawn and were sufficiently comprehensive to protect the subject they disclosed, yet it is doubtful if they would have been maintained and their validity established in the courts had they not fallen into the hands of the "Patent Pool Trust." The owners of the Tesla patents, realizing the great weight of public opinion and its effect upon the courts before which the patents would surely be brought for adjudication, early began a systematic campaign of personal publicity, in which the wonderful achievements of Mr. Tesla were set forth with the coloring of a gold mine prospectus; and their efforts to fasten attention upon the inventor and his work were ably supplemented by numerous startling statements, promises and disclosures that he himself constantly poured forth. Surely, at this time his oracular activity was remarkable.

When, therefore, the Tesla patents were brought into court and the picturesque wizardship of the patentee was frequently contrasted with the simple and modest researches of prior investigators, the courts quite innocently swallowed the bait prepared for them and rendered verdicts for the "Patent Pool Trust." To-day the Tesla (1888) patents have ceased to exist, the "Patent Pool" campaign is over, the object for which the patents were created has been accomplished and all pecuniary interest in the maintaining of patents have vanished. There is now, it seems to me, no valid reason why all engineers in this country may not unite in the future "to render unto Cæsar the things that are Cæsar's," and may further find expression for the sentiment by prefixing the name of Ferraris to devices containing the principles he first discovered.

Polyphase Patents.

The Westinghouse Electric & Manufacturing Company has announced in connection with the expiration this week of the three fundamental Tesla patents, that it holds numerous other patents relating to polyphase synchronous motors and subsidiary apparatus. Seven of these patents were granted to Nikola Tesla on dates between September 3, 1889, and January 2, 1894, the subjects being as follows: Induction motors; the use of the induction motor as a starting device for the synchronous motor; relation between the number of poles on generator and motor, and four patents on the split-phase method of operating motors. Three of the list of patents were granted to Hutin and Leblanc, the subjects being damping devices for alternating-current motors, variable-speed induction motors, and alternating-current transformation. Nine patents were granted to Mr. B. G. Lamme, the subjects being induction motors, starting arrangements for induction motors, and alternating-current motor. Of the

remaining patents, two were granted to Mr. William Stanley for an alternating-current motor with compensated field and a self-regulating transformer (1892), another to Nolan for armature core construction and two others to Dusinberre for induction motors.

Stanley Transformer Patent Decision.

The United States Circuit Court of Appeals for the Second Circuit, Judges Wallace and Townsend on the bench, has refused an application for a preliminary injunction in the case of the Westinghouse Electric & Manufacturing Company and the Montgomery Electric Light & Power Company, the issue being alleged infringement by the latter of the Stanley 1892 transformer patent, the infringing device being a Wagner transformer. Judge Coxe in the court below had granted an order for a preliminary injunction which was the subject of the action of the higher court. The lower court held that the defendant's system of electrical distribution infringed the first and third claims of the Stanley patent, whether the length of the primary coil of its transformer had been ascertained by applying the so-called "Stanley Rule" or by some method of which Stanley was not the discoverer. The court states that to this extent it agrees with the court below, but that it is not convinced that in the Wagner transformer used by the defendant there is the length of the primary wire required by the "Stanley Rule," nor that as the primary and secondary coils are disposed in the Wagner transformers, the Stanley length would not be destructive of the commercial value. In view of the large importance of the controversy, the court held that the rights of the parties should be reserved for a decision until the final hearing of the cause.

The patent at issue was that which figured in the case of the Westinghouse Electric Mfg. Co. vs. the Saranac Lake Company, in which it was held that a Stanley transformer in suit infringed the early Stanley patent on the ground that the length of wire in the primary coil was substantially the same as it would have been if such length had been determined by the "Stanley Rule," this rule forming part of the specifications of the patent and being held by the court to be equivalent to the claims of the patent.

International Railway Congress at Washington.

Large numbers of delegates have been arriving during the past week from Europe to attend the International Railway Congress, which is being held in Washington from May 3 to 14, inclusive, with headquarters at the New Willard Hotel and sectional meetings there and at the Ebbitt and Raleigh Hotels, one section meeting also in the hearing room of the Interstate Commerce Commission. The congress was called to order at the Willard on May 4. Associated with the convention is the American Railway Appliance Exhibition in the mall around the Washington Monument, occupying nine acres, and filled with hundreds of exhibits, many of which are housed in special temporary buildings.

The following is the general programme, in the rough, which has been preceded by visits and trips and entertainments in New York and Philadelphia: Friday and Saturday, May 5 and 6, at 9.30 a.m. and 2 p.m., meetings of the sections. Sunday, May 7, will be given up to resting. Monday and Tuesday, May 8 and 9, at 9.30 a.m. and 2 p.m., meetings of the sections. At 7.30 p.m., Tuesday, May 9, a banquet given by the American Railway Association. Wednesday, May 10, at 9.30 a.m. and 2 p.m., meetings of the sections. Thursday, May 11, meeting of the sections at 9.30 a.m. At 2 p.m. a general meeting, followed by a banquet. Friday, May 12, 9.30 a.m., meeting of the sections. At 2 p.m., general meeting. Saturday, May 13, at 9.30 a.m., meeting of the sections. At 2 p.m., general meeting and formal closing of the session.

Electric traction will be discussed by Section 2, under the general questions of "Progress Made in Electric Traction on Important Lines of Railways," "Continuous Current, Alternating Current, Polyphase Current" and "Experiments Made with High-Tension Currents." The reporters are as follows: America—Mr. W. F. D. Young, electrical engineer Baltimore & Ohio Railroad. France—Mr. Paul Dubois, engineer of bridges and highways, engineer of the central service motive power of the Orleans Railroad, Paris. Great Britain and Belgium—Mr. Ernest Gerard, general inspector, chief of the cabinet of the Belgium Minister of Railways, Brussels. Other Countries—Mr. Victor Isemontani, chief inspector of the electrical section of the Mediterranean Railway, Milan.

The lighting, heating and ventilating of trains will be discussed by Section 2 and Section 3 conjointly. Automatic block systems will be discussed by Section 3.

On Sunday, May 14, a start will be made on the tours of inspection by the foreign delegates. The itinerary will be about as follows: The short tour includes visits to Altoona, Pa.; Pittsburg, Pa.; Cleveland, Ohio; Buffalo, N. Y.; Niagara Falls, Schenectady, N. Y., and Boston, Mass. This tour will occupy the time from the evening of Sunday, May 14, to the morning of Tuesday, May 23. The party will arrive on the return at New York. The total length of this trip is about 1,500 miles.

The long tour includes visits to Altoona, Pa.; Pittsburg, Pa.; Cincinnati, Ohio; St. Louis, Mo.; Chicago, Ill.; Buffalo, N. Y., including Niagara Falls, Montreal, Canada, and Schenectady and Saratoga, N. Y. This tour will occupy the time from the evening of Sunday, May 14, to the evening of Saturday, May 27, when the party will arrive on the return at New York.

At Pittsburg the delegates will visit the works of the Westinghouse Electric & Manufacturing Company, where luncheon will be served on Tuesday, May 16.

At Schenectady a trip will be made through the works of the General Electric Company's plant, Saturday, May 20, and the party will also be entertained there by the officers, while an opportunity will be given to see the new electric locomotives for the New York Central Railroad.

At Cincinnati a party will visit the works of the Bullock Electric Manufacturing Company at Norwood. Luncheon will be served after the inspection of the works.

The preliminary entertainment in New York last Monday was of a most agreeable character. The local committee were: Chairman, W. G. Besler; secretary, Frederick H. Meeder, and H. H. Vreeland, A. H. Smith, D. W. Cooke, C. L. Addison, George H. Campbell, M. B. Cutter, George L. Connor, Richard W. Meade, T. E. Clarke, George T. Smith, George H. Daniels, Louis T. Ford, Ralph Peters and B. B. Adams. The visits included the New York Central and Pennsylvania and Long Island Railroad termini. At the Interborough plant the delegates were met by Mr. Frank Hedley, general manager, while President Vreeland did the honors for the New York City Railway. On Tuesday at Philadelphia the visitors were received by a committee, of which Mr. John H. Converse was chairman, and they were given a banquet at the Baldwin Locomotive Works.

The Theory of Probability and Telephone Traffic.

At the Chicago meeting of the A. I. E. E. April 25, 1905, Mr. M. C. Rorty, of Pittsburg, read a paper on "Applications of the Theory of Probability to Telephone Traffic." Chairman Kempster B. Miller, of the Chicago branch, in introducing Mr. Rorty, said that the subject was one which, although of great importance, had never before been considered at any technical meeting of telephone engineers. Mr. Rorty's paper, being largely mathematical, hardly permits of abstract here. It applied mathematical formulæ of probability in determining the maximum telephone traffic likely to occur during any one minute or hour. With the capacity of operators to answer calls being known, the probable breaking down point of the telephone service could, therefore, be determined. The question would then come down to one of how much the company would think best to spend to guard against certain chances of being overwhelmed with calls at certain times. Mr. Rorty would take into account, first, all the known elements likely to cause variations in telephone traffic and then apply the laws of probability to determine the maximum load on the system.

The discussion was taken part in by Mr. A. P. Allen, traffic engineer of the Central Union Telephone Company, Indianapolis; A. S. Hibbard, general manager of the Chicago Telephone Company; S. J. Larned, general superintendent of the Chicago Telephone Company; J. G. Wray, superintendent of maintenance of the Chicago Telephone Company; Frank R. McBerty, of the Western Electric Company, and F. J. Dommerque, of the Kellogg Switchboard & Supply Company.

Annual Report of the General Electric Co.

The General Electric Company has just issued its thirteenth annual report, constituting a document of much interest and importance, characterized by the usual fullness and clearness. The statements made by President Coffin, for the year ending January 31, 1905, are as follows: "The profits of this company for the past year (including $281,927.34 from securities sold, and $465,716.73 from royalties, dividends, sundry profits, etc.), after deducting all general and miscellaneous expenses and allowances for depreciation and losses, and writing off $593,624 from patent account, and $1,778,492 from factory plants and machinery, were $6,719,546; less net debit to profit and loss in revaluing the assets of the Stanley Electric Manufacturing Company, and other acquired interests of $759,654; paid in dividends during the year $3,684,384, leaving a surplus for the year of $2,275,508. The sales billed by your company to its customers for the past year were about $2,500,000 less than for the previous year, showing a shrinkage in business done of about 6 per cent. It will be observed that the amount written off from factory plants is substantially 60 per cent of the cash expended thereon during the year. It is expected that expenditures of this nature will be smaller during the current year than in either of the two previous years."

First Vice-President Griffin says in part:

"Among the important contracts are: Contracts with the New York Central Railroad for thirty 90-ton electric locomotives, for 40,000 kw capacity steam turbines, for entire switchboard plants for the Mount Morris and Yonkers power stations. Contracts with the Public Service Corporation of New Jersey for steam turbines and rotary converters with compliments of transformers, switchboard apparatus, etc. Contracts with Interborough Rapid Transit Company, of New York City, for additional control equipments and motors for operation of the Subway trains. Contracts for car equipments with the New York City Railway Company, the Philadelphia Rapid Transit Company, the Chicago Union Traction Company, the Boston & Northern Street Railway Company, the Old Colony Street Railway Company, the United Railroads of San Francisco and other traction and street railway companies. Contracts for generators to develop water powers in ten of the United States and in Mexico and other foreign countries. Contracts for 154 steam turbines with eighty-six corporations and individuals. The first high-speed passenger locomotive for the New York Central Railroad has been thoroughly tested with satisfactory results. The electrical work of the New York Central Railroad has excited much interest among the officials of other railroads, and from the numerous inquiries and requests for plans and estimates which we receive it is evident that we are entering upon a most interesting phase of electrical development in connection with steam railroads, and that it will not be many years before all suburban trains in the vicinity of our large cities will be operated by electric power.

"During the year we received 187,350 separate orders (not including contracts), an average of 624 per working day. The average orders per day indicate the growth of the business, as follows. Average number of orders received per working day, year ending January 31:

1900	473	1903	541
1901	500	1904	570
1902	533	1905	624

"While our total business was less in 1904 than in 1903 in money value, the number of contracts and orders was greater, resulting in more work for the organization. Where a customer placed one large order in 1903 he placed several small orders in 1904; where a customer promptly decided on his requirements in 1903 he asked for and considered many alternate propositions in 1904. More work for the same volume of business was required of our salesmen, engineers, manufacturers and managers in 1904 than in 1903."

Vice-President E. W. Rice, Jr., says in part: "About $2,000,000, exclusive of the cost of patterns, special tools, etc., has been expended during the year for real estate, erection of new factories, extensions to existing buildings, and for additional machinery. The lands of all three plants now amount to about 425 acres. The total book value of the land and buildings of the Schenectady, Lynn and Harrison factory plants is $4,593,813, or about $1.12 per sq. ft. of manufacturing floor space. Engineering effort has, as in the past, been largely devoted to the extension, improvement and cheapening of our established lines of apparatus. The commercial success of long distance transmission systems is generally recognized, and the number of such undertakings has increased.

"It is not practicable even to mention the constantly increasing number of applications of electric motors. One interesting instance is that of the high-speed electric motor centrifugal pump, which promisés to replace the steam pump for supplying water to cities. The electric pump occupies about one-quarter of the space, costs less and is more efficient than the present steam pump.

"Our line of steam turbine generators has been extended and improved, and a large number of important installations were made during the year. The New York Central Railroad ordered eight 5,000-kw turbo-generators for supplying the electric energy for that portion of its road between Croton and the Grand Central Station, which it is proposed to electrify.

"The first of the locomotives built for the New York Central Railroad was subjected to its initial tests on the Central tracks west of Schenectady on October 27, 1904. The locomotive was tested in daily operation under all conditions for several months. It attained a speed of 52 miles per hour with a 550-ton train and 69½ miles per hour with a 265-ton train. These are official figures with a four-mile-track. After the track was extended to six miles, unofficial tests showed a speed of 75 miles per hour. The tests were satisfactory in all respects.

"Our new alternating-current railway motor has been successfully employed on two tramways, and a number of additional orders have been received. This novel form of motor is under certain conditions cheaper and more economical than our standard direct-current motor, and the field of electric traction will be extended by its use.

"We have succeeded in still further improving the design and reducing the cost of our standard switchboard devices, and as heretofore have obtained the bulk of orders in this important line."

The report also states that the company has no note payable, and that during the past year the company has not borrowed money or incurred obligations; nor has its credit been used either by issuing notes, indorsing customers' paper for discount or lending its name in any way. Its established policy of maintaining sales on a basis of cash, or short credit to desirable customers, has been adhered to.

Account compares as follows:

	1905.	1904.	1903.	1902.
Gross receipts	$40,232,354	$42,783,804	$39,122,051	$33,852,363
Exp., etc.	33,603,808	34,994,434	28,889,212	25,296,432
Net	$6,719,546	$7,789,370	$10,232,839	$8,555,931
Pfd. div.	.....	.....	.....	83,689
Com. div.	3,684,384	3,508,284	2,677,263	1,871,968
Surplus	$3,035,162	$4,281,086	$7,555,576	$6,600,274
Written off	759,654	1,470,099	1,613,880	
Surplus	$2,275,508	$2,810,987	$5,941,696	$6,600,274
Prev. surp.	7,293,689	4,482,702	15,287,140	6,629,181
Total	$9,569,197	$7,293,689	$21,228,836	$13,229,455
Enhancement book val. stocks and bonds	.....	.....	.....	2,057,685
Stock issued '02 for deduct.s in '98	.....	.....	16,746,134	.....
P. & L. surplus	$9,569,197	$7,293,689	$4,482,702	$15,287,140

The general balance sheet as of January 31, 1905, compares as follows:

Assets—	1905.	1904.	1903.	1902.
Pats, franchises, etc.	$2,000,000	$2,000,000	$2,000,000	$2,000,000
Factory plants	7,500,000	6,500,000	5,000,000	4,000,000
Real estate	359,980	424,083	431,456	464,197
Stocks and bonds	14,488,269	14,665,346	12,682,215	9,825,121
Cash	6,529,116	3,289,445	3,632,556	4,058,448
Notes and acts., rec.	16,747,449	15,207,481	12,816,607	11,364,345
Work in progress	2,009,805	2,046,488	1,769,456	1,338,259
Invent., factory	10,336,737	10,488,465	10,297,595	7,742,606
Invent., gen. and local offices	1,519,182	1,247,754	1,165,921	1,037,968
Invent. consign.	143,806	69,899	97,701	96,309
Total	$61,634,345	$55,938,962	$49,893,507	$41,927,252
Liabilities—				
Capital stock	$48,247,943	$43,866,700	$41,880,733	$24,910,900
5 per cent. gold cp. deb.	78,000	82,000	99,000	372,000
3½ per cent. gold cp. deb.	2,049,400	2,049,400	2,049,400	.....
Accrued inter.	650	683	825	3,100
Accts. payable	1,345,145	1,810,664	1,378,960	1,349,335
Unclaimed div.	2,011	1,825	1,886	4,776
Def. liab.	342,000	834,000	.....	.....
P. & L. surplus	9,569,197	7,293,689	4,482,702	15,277,141
Total	$61,634,345	$55,938,962	$49,893,507	$41,927,252

The total sales (amount billed to customers) and orders received for the year compare as follows:

	Amt. billed.	Orders rec'd.
1899	$15,679,430	$17,431,327
1900	22,379,463	26,323,626
1901	28,783,275	27,969,541
1902	32,338,036	34,350,840
1903	36,685,598	39,944,454
1904	41,699,617	39,060,038
1905	39,231,328	35,094,807

Reduced Telephone Rates in New York and in Boston.

The New York Telephone Company on April 27 announced a new schedule of rates for large users of the service in Manhattan, to take effect on June 1. The minimum equipment coming under the new schedule consists of a local switchboard, two lines to central and two stations. For a subscriber thus equipped the charge for 3,600 local messages will be $216 a year, instead of $240 as formerly. For each additional wire to the central office the additional charge will be $24 instead of $36. For twenty or less additional stations the charge will be $9 each instead of $12, and for more than twenty stations $6 each instead of $12 will be charged. Mileage charges for private wires, which ranged in price from $60 to $84 a mile, have been reduced to range between $48 and $60 a mile. The charge for local messages in excess of 3,600 will be 4 cents each as heretofore, or when contracted for in advance in lots of 400, $3 per 100.

On May 1 some substantial reduction in the telephone rates for certain classes of service in the Boston metropolitan and suburban exchanges were put into effect by the New England Telephone & Telegraph Company. The reductions have been made according to the policy recently inaugurated of reducing the rates as far as the operating expenses would permit. The suburban measured service exchange rates, including exchange service with subscribers connected with the Main, Back Bay, Haymarket, Oxford, Richmond and Tremont exchanges, show the reductions as compared with the old rates, as follows:

SPECIAL CIRCUIT.

	New rate.	Additional calls.	Old rate.	Additional calls.
600 calls	$60.00	5c. each	None.	
700 calls	65.00	5c. each	$70.00	6c. each
800 calls	70.00	5c. each	75.00	6c. each
900 calls	75.00	3c. each	80.00	6c. each
1000 calls	78.00	3c. each	85.00	4c. each

TWO- PARTY CIRCUIT.

500 calls	$45.00	5c. each	$50.00	6c. each
600 calls	50.00	5c. each	55.00	6c. each
700 calls	55.00	3c. each	60.00	6c. each
800 calls	58.00	3c. each	65.00	4c. each
900 calls	61.00	3c. each	68.00	4c. each

For the suburban measured service, exchange rates allowing communication only between subscribers to the suburban exchanges on special circuit have been cut from 4 to 3 cents for additional calls, the rate for 600 calls, $48, remaining the same. On the two-party circuit the rate also remains the same, with a cut from 4 to 3 cents for additional calls.

On the unlimited suburban exchange, rates for residence stations for the special line have been cut from $66 to $54. On the two-party circuit from $51 to $42, while for four parties on one circuit there will be a new rate of $30. It is thought that these reductions will benefit a large number of the company's patrons and will enhance the value of the exchanges.

Disastrous Legislation Threatened in Illinois.

Electric lighting and gas companies doing business in the State of Illinois are extremely apprehensive of legislation which is being vigorously urged by certain people at the State Legislature at Springfield. The bills proposed give the City Councils the power to determine the rates which companies can charge for gas and electric light. It is hardly necessary to say that this puts it in the hands of the City Council to bankrupt any electric light or gas company at will. The agitation in favor of this legislation comes mainly from the city of Chicago, where there is a feeling that the rates for gas lighting are too high. There does not appear to be much sentiment one way or another in regard to electric lighting rates, but since electric light companies are also in the business of furnishing light, they have been included in the bills as well as the gas companies. The electric lighting interests of the State are willing to have legislation which will provide for reasonable regulation of rates or for protection of the public against companies which fail to do their duty as to quality of service rendered, but they do not want it put within the powers of any erratic City Council to ruin a business in which millions of dollars have been invested. It is, of course, questionable whether such a law will be found constitutional should it be passed and a test case made. There is but little question that the courts will protect the rights of the company as long as the charges are fair and the service good, but no company likes to be put in a position where hasty action by a City Council can involve it in a long course of litigation, during the progress of which the company's financial future is a matter of question.

National Electric Light Convention.

Elaborate arrangements are being completed by Colorado central station men for the reception and entertainment of delegates to the convention of the National Electric Light Association, which meets in Denver and Colorado Springs the week of June 5. From the arrival of the delegates and their friends on the morning of June 5 until the end of the deliberations of the convention, one continual round of pleasure is promised.

On Monday night an informal reception will be held at the Brown Hotel, the headquarters of the convention. All of the delegates will have a chance to renew their acquaintance with each other on this occasion and will be given a chance to inform themselves on what will be doing on the days following. A feature of the week's entertainment will be a "broncho-busting" contest. The committee in charge of this affair has labored hard for the past few weeks to secure a cow puncher who could get the worst acting bronchos in Wyoming and Colorado for the contest, and the members believe they have succeeded. An old cowboy who knows the range from A to Z is in search of the worst "outlaws" in Colorado and Wyoming, and when he arrives in Denver with his band of bad actors in a few weeks, he will have a bunch of horses that will test the horsemanship of the large number of expert riders who will assemble convention week to take part in the contest.

A day will be set aside for the entertainment of the ladies who will go to the convention with the delegates. The women members of the Denver Country Club, an organization that owns probably the finest golf course between Chicago and San Francisco, will provide a novel entertainment for the visiting ladies one afternoon of the days to be spent in Denver and it is unnecessary to state that the affair will be enjoyable. One evening has been set aside for the entertainment of the party at Elitch's Gardens, an amusement resort which has become widely famous for its excellent stock companies. Mrs. Elitch, the owner of the gardens, gathers together each season the best actors and actresses she can secure for the summer, and the delegates can expect to see a splendid production.

On Friday morning a special train will take the delegates over the Divide to Colorado Springs, where committees will take charge of the party. Visits will be made to all the scenic points in the vicinity of Colorado Springs and Manitou. As there is much to see, the entire day will be consumed in interesting journeys into the canyons and mountains where one may feel the exhilaration which comes with every breath of Colorado ozone.

Saturday morning the delegates will be given probably the most interesting trip of the week. They will be taken over the Short Line railroad, which climbs a very steep grade to the Cripple Creek district. The road is built in such a way as to give a splendid view of the scenery for hundreds of miles from the train as it gradually ascends the mountain peaks on its way to the greatest gold camp in the world. When the camp is reached, the guests will be taken to the greatest of the gold producers. The history of these mines is rich in anecdote of the men who made them famous, and the delegates will learn much that they will treasure up in their minds for years to come. Those who are camera experts will be greatly rewarded by the trip, as there is a multiplicity of scenes for subjects of good pictures. On the return of the special to Colorado Springs the visitors will be asked to go to the Broadmoor Casino, where further entertainment will be provided. This is a splendid resort situated a few miles outside of Colorado Springs, and the delegates will have an opportunity of recuperating from the effects of the day's sightseeing.

The majority of the delegates will return to Denver on Monday. As several of the railroads have arranged to have excursions to the best scenic points in Colorado on Monday and Tuesday, the delegates will be able to take any one of these trips at a very small expense.

In buying tickets to the convention, the following suggestions will be of value: On the Union Pacific, Burlington and Rock Island tickets should read, "Through Denver to Colorado Springs, with stopover at Denver"; on the Santa Fé and the Missouri Pacific they should read, "Through Colorado Springs to Denver, with stopover in Colorado Springs on the return trip." This does not mean any additional expense, and the railroads have agreed to the stopover. The rates already obtained are low, but they may go still lower.

Report of New York Lighting Investigation.

The recent investigation of lighting conditions in New York City by the Stevens Committee has resulted thus far in what may perhaps be described as a fizzle, owing to the fact that both branches of the Legislature at Albany declined to receive the report. The principal recommendations made are as follows:

"First, that the price of gas sold in the Boroughs of Manhattan and Brooklyn, and in that part of the Borough of the Bronx west of the Bronx River, should be fixed at a maximum of 75 cents per thousand cubic feet.

"Second, that the pressure of gas in any of the street mains should not be permitted to exceed two and a half inches, or to be less than one inch.

"Third, that the standard of purity and of illuminating power of gas should be fixed.

"Fourth, that a proper system of inspection be provided to secure enforcement of the law with reference to pressure, purity, illuminating power and accurate measurement of the gas delivered.

"Fifth, that the price of electric current for heat, light and power purposes in the Boroughs of Manhattan and Brooklyn, and in that part of the Borough of the Bronx west of the Bronx River, should be fixed at a maximum of 10 cents per kilowatt-hour of current actually consumed, and that provision should be made for inspection to secure accurate metering.

"Sixth, that the price of arc lamps for street lighting in the City of New York should be fixed at $100 per lamp per year for single lamps of 2,000 candle-power, consuming 450 watts at the arc, and that the price of twin arc lamps, consuming 250 watts each at the arc, should be fixed at $65 each per year.

"Seventh, that the City of New York be given authority to utilize water power, now owned or hereafter acquired by it, for the purpose of generating electric current for the use of the municipality, provided that no additional water shall be used for said purpose that would otherwise be required by the city.

"Eighth, that provision should be made for the creation of a commission, the members of which should be appointed by the Governor with the consent of the Senate, to be paid by the State, and to have general supervision of all persons and corporations having authority to lay or erect and maintain wires and pipes for the purpose of furnishing gas or electricity for light, heat or power, with power to investigate and ascertain the character of the service and reasonableness of charges and the methods employed in manufacture and distribution and in the maintenance of works and distributing systems and to enforce the provisions of law applicable thereto; to prescribe methods of keeping accounts; to examine the corporations under its supervision; to require annual reports; to examine books and papers and compel their production; to subpoena witnesses and to take testimony; to supervise issues and increases of securities, investments in stocks, the stocks or bonds of other companies, and transfer of franchises and to regulate rates within the limits prescribed by law. It should be provided that the orders of said commission in confirmation by the Supreme Court at Special Term shall be enforcible by punishment for contempt in case of disobedience."

There are four bills to carry into effect the lighting recommendations. The first fixes the price of gas, the second provides for inspection of meters, the third the rates for electricity, and the fourth creates a state lighting commission. The report consists of nearly 100 closely printed octavo pages and embodies and reviews 400,000 words of evidence.

Magnetite Arc Lamps at Jackson, Mich.

The Commonwealth Power Company, of Jackson, Mich., has 300 magnetite arc lamps in use for street lighting. J. B. Foote, general superintendent of the company, reports that these are giving excellent satisfaction. Luminometer tests show that a given size of type can be read by these lamps almost twice as far as by the 6.6-amp., enclosed series, alternating arc lamp which the company has now in use in some of its other plants. The magnetite lamps uses a current of 4 amp. with 80 volts at the lamp, making a consumption of 320 watts. The company is much pleased with the results now being obtained. The lamps are run off of direct-current arc dynamo circuits.

The Interstate Electric Railway Association.

Representatives of ten interurban electric railway companies of the States of Illinois and Wisconsin met at Rockford, Ill., April 18, and formed an organization to be known as the Interstate Electric Railway Association. This title was selected because the Wisconsin companies wished to join. The officers elected were as follows: President, E. C. Faber, general manager of the Aurora, Elgin & Chicago Railway Company, Wheaton, Ill.; secretary, John T. Huntington, general manager of the Elgin, Aurora & Southern Traction Company, Aurora, Ill. Eleven companies have joined the association at present writing. The president will probably call a meeting of the association soon, when a constitution and by-laws will be adopted and further details of organization perfected. One of the objects of the organization is to arrange for an interchangeable coupon ticket similar to that adopted by the roads west of Chicago.

CURRENT NEWS AND NOTES.

INDEPENDENT TELEPHONE DINNER.—The Indianapolis Telephone Company and the New Long-Distance Telephone Company will give a dinner at the German House, Indianapolis, Ind., May 10, to officers and managers of the independent telephone companies and exchanges in the State. Several gentlemen connected prominently with the independent telephone movement of the country expect to be present and a large attendance is looked for.

POWER REQUIRED BY TEXTILE MACHINERY.—At the recent meeting of the Cotton Manufacturers' Association, Mr. Louis I. Guion read a paper entitled "Electrical Measurement of Power Required in Manufacturing Heavy Cotton Goods," which gives very complete data on the subject. The tests were conducted by the Columbia Mills Company, of Columbia, S. C., which has a capacity of 23,240 spindles, and is equipped for the manufacture of various classes of duck from raw material to finished goods.

OHIO ENGINEERS' MEETING.—The tenth meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers will be held at Toledo, May 19 and May 20. An excellent programme has been prepared, among the papers being the following: "Losses in the Power Plant," by Charles W. Harvey; "Power Plant Supervision and Accounting," by F. W. Ballard; "Some Recent Improved Forms of Electric Lamps," by Prof. F. C. Caldwell. Other papers dealing with subjects of mechanical interest will also be read. Mr. Corwin J. Miller, Canton, O., is secretary of the association.

NEUTRALIZING STATIC ELECTRICITY.—A paper read at the meeting last week of the New England Cotton Manufacturers' Association describes the Chapman process for removing static electricity generated in weaving processes. This device, which is also used largely in paper mills and printing pressrooms, consists of a transformer stepping up an alternating current to between 10,000 and 20,000 volts, and an inductor of fine steel wires encased in hard rubber, which is arranged with the points above the web or other work in which static electricity is to be neutralized. Charges pass from these points to the web and neutralize the static electricity which is found troublesome in certain textile processes.

THE MECHANICAL EQUIPMENT OF LIGHT.—At the recent meeting of the National Academy of Sciences in Washington, Prof. E. L. Nichols, of Cornell, stated that the values assigned to the mechanical equivalent of light by Julius Thomsen, Tumlirz and Angström were in the ratios of 19, 13 and 7, respectively, and gave a number of reasons for believing that Angström's value was the only trustworthy determination. In attempting to remove all the invisible rays from a Hefner flame in order to measure the intensity of the remaining visible rays, Thomsen and Tumlirz had passed the light through water. Angström used a more difficult method, but was enabled to correct for the errors introduced. By a photometric comparison with the bare flame, he determined the value of the visible rays absorbed in his spectroscope and thus eliminated the error due thereto. His value alone is capable of reconciliation with Langley's bolometer results and various other observations. According to the determinations of Tumlirz, a unity efficiency light would give about 5.3 candles per watt.

EUROPEAN RAILWAY PROJECTS.—The Societa Unione Italiano Genovese dei Tramways Electrici, Genoa, Italy, has secured a tramway concession in that city. The tramways of Barcelona, Spain, are to be changed to electric traction. They are operated by the Compania Central de Ferrocarriles y Tranvias de España, Barcelona.

EXTENSION OF SAN JOAQUIN TRANSMISSION PLANT.—The San Joaquin Power Company, Fresno, Cal., will very considerably extend its transmission plant. An order has been placed with the Allis-Chalmers Company for hydraulic machinery, two 1,000-kw Bullock alternators and seven 300-kw transformers. The alternators will generate three-phase currents at 550 volts, 60 cycles, which will be stepped up to 19,500 volts for transmission.

CHICAGO MEETING A. I. E. E.—The next meeting of the Chicago branch of the A. I. E. E. will be held at the usual place in the Monadnock Block, May 23. The papers by Messrs. Damon and Varney on "High-Pressure Line Construction for Alternating-Current Electric Railways" will be discussed, and James R. Cravath will also present a paper on "Light Electric Railways." The first two papers were presented in New York, March 24. The latter will be presented in Chicago for the first time.

CHEMICAL ENGINEERING AT COLUMBIA.—A four-years' course in chemical engineering, leading to the degree of chemical engineer, has been established at Columbia University, the first year of which will go into effect in September, 1905. The course will not only touch on electrochemical engineering, but will comprise the study of general electrical engineering principles including the elements of the dynamo, distribution of electric power, direct and alternating-current machines.

CABLE TO CAROLINE ISLANDS.—The Commercial Cable Company announces that cables have been laid in connection with the Commercial Pacific cable to the Caroline Islands and the Dutch East Indies, and are now open for public use at the following rates from New York: To the Caroline Islands and Java, $1.20 per word; to Sumatra and other islands, $1.30. The Caroline Islands consist of a group of small islands about 1,000 miles east of the Philippines. They belong to Germany.

THE TECHNIQUE, an annual publication of the junior class at the Massachusetts Institute of Technology, was placed on sale April 27. It contains a fine portrait of President Roosevelt, and prints a letter which the President sent to the editor for dedicating the publication to him. After thanking the editors and readers for the dedication, the President points out the great chance to influence for good which the graduates of the institute have as engineers in securing a healthy working agreement between the representatives of capital and labor.

CORNELL UNIVERSITY.—The register of Cornell University for 1904-5 shows that the total number of students enrolled is 3,230, exclusive of 879 students taking short-course and summer-term work. In the former number are included 303 students attending the Cornell Medical College in New York City. The largest single department of the university is Sibley College of Mechanical Engineering, the number of students in which is 1,039. The list of candidates for degrees in June, 1905, shows 205 mechanical engineers (including electrical engineers), and eight masters of mechanical engineering in Sibley College.

ARMOUR INSTITUTE OF TECHNOLOGY.—The Institute offers summer courses designed to meet the wants of teachers and special students, who desire to extend their knowledge of scientific and technical subjects; of undergraduates, who desire to shorten their regular courses; of new students, who are deficient in certain studies required for admission, and of those who are unable to attend during the school year. The courses include electrical engineering, a special course in electricity, telephone engineering, chemistry, civil engineering, practical shop work, physics, mathematics and drawing. The summer session begins Monday, June 26, and ends Friday, August 4.

ELECTRIC TRACTION DATA.—In a lecture recently delivered by Mr. Hylon T. Plumb at Purdue University on "The Possibilities of Electric Traction," it was pointed out that a pound of coal converted into electric energy will haul a given load three or four times as far as when burned in a steam locomotive. Referring to the conditions of profitable operation, it was stated that a successful interurban road must have a contributory population of 1,000 inhabitants per mile of line, and must not cost more than $25,000 per mile to construct. Steam railroad managers have estimated that a trunk line must have a daily traffic of 10,000 ton-miles per mile of double track before electrification would be financially advisable.

SOCIETY OF POST OFFICE ENGINEERS.—At a conference of electrical engineers in the British Post Office service, recently held in London, it was decided to establish a society to be known as "The Society of Post Office Engineers." About 100 engineers were present, including delegates representing post office engineers to the number of 200 in England outside of London, and in Wales, Scotland and Ireland. At this meeting the following officers were elected: President, Mr. D. H. Kennedy, London; vice-president, Mr. P. Jarvis, Sunderland; treasurer, Mr. J. M. Crawford, London; secretary, Mr. J. W. Atkinson, 45 Arbuthnot Road, New Cross, London, S. E. The organization will be completed at an early date and a programme of papers arranged for the first public meeting.

LORD GREY A GOTH.—In view of the wild denunciations in the press of those who are developing the power of Niagara, it is of interest to quote this dispatch of April 29 from Niagara Falls: "Earl Grey, Governor-General of Canada, with Countess Grey, their daughters and a large party, visited Niagara Falls to-day and made a tour of the works of the Electrical Development Company and the Canadian Niagara Power Company, on the Canadian side of the river, and the Niagara Falls Power Company, on the American side. While the party were in the big tunnel of the Electrical Development Company it was suggested that Lord Grey lay a few bricks, and workmen handed trowels to the Earl, the Countess and the Ladies Evelyn and Sybil Grey, who placed a whole tier of bricks in a most satisfactory manner." All four are now *particeps criminis* and quite pleased.

MILWAUKEE MUNICIPAL PLANT.—The municipal electric light plant agitation in Milwaukee, Wis., is suffering from a reaction and the sentiment of city officials in regard to the matter has, it is stated, entirely changed. The bombshell came in the form of a proposition from President John I. Beggs, of the Milwaukee Electric Railway & Light Company, who made a definite offer to furnish street lighting at a maximum price of $65 per lamp per year. The officials now say that nothing could be gained if the city built its own plant, as long as a private company is ready to furnish the light at a low figure; that the city would not be compelled to invest over $600,000, which is needed for necessary improvements; that it would not be necessary to tear up all the streets, and that the city would not be compelled to venture upon a proposition which might turn out to be a costly experiment.

HARVARD-TECHNOLOGY ALLIANCE.—The executive committee of the Alumni Association of the Massachusetts Institute of Technology has issued to the former students of the Institute a number of documents outlining the advantages and disadvantages of the proposed agreement with Harvard University. The documents transmitted are as follows: A brief history of the proposed agreement, extracts from the will and codicils of the late Gordon McKay; maps of Boston and vicinity, showing relation of lines of transportation to the proposed location of the Institute; a general view of the proposed plan for co-operation in technical education between Harvard and the Institute, by Henry S. Prichett; a financial statement by the treasurer of the corporation, George Wigglesworth; a statement presenting the advantages of the proposed agreement, prepared at the request of the executive committee of the Alumni Association, by John R. Freeman, Eben S. Draper and A. Lawrence Lowell; statements presenting the disadvantages of the proposed agreement, prepared at the request of the executive committee of the Alumni Association, by Francis H. Williams and James P. Munroe and by Thomas L. Livermore. The students were invited to transmit to the secretary before May 3 any questions regarding the proposed agreement which they would like to have answered, so that these questions might be given consideration before a meeting of former students to be held May 4 in Huntington Hall, Boston.

A MUNICIPAL OWNERSHIP FAILURE.—The town of Willow Springs, Mo., after an experiment in municipal ownership, wishes to lay down the burden. It is reported that offers will be welcomed to take over the present water works plants, and that liberal franchise terms will be granted to the purchaser for the addition of an electric lighting and ice-making plant. Mr. E. M. Whitman is mayor.

ELECTRICITY IN SLEEP.—At a meeting in Rome, Italy, on April 29 of the International Psychological Congress, Miss Louise Robinovitch, an American, delivered a lecture on electric sleep-making. She endeavored to prove that sleep obtained by this means is natural and not epileptic. Various devices are already known to produce sleep or surcease from pain by electrical methods and it is not stated whether Miss Robinovitch had anything new up her large sleeves.

THE CHICAGO SUBWAY.—It is stated that the Chicago subway is benefiting to the extent of many hundreds of tons of freight a day as a result of the teamsters' strike in Chicago. All concerns affected by the strike are availing themselves of the services of the subway. The company is constructing new subways at the rate of two or three miles a month, and it is predicted that within the next ten years the company will be operating in the neighborhood of 150 miles of track in Chicago and vicinity.

RAILROAD GASOLINE CAR.—G. H. Groce, telegraph superintendent of the Illinois Central Railroad, has returned to Chicago from Omaha, Neb., where he was sent by the executive officers of the company to investigate the new gasoline motor car of the Union Pacific Railroad. In his report to General Manager Rawn, Mr. Groce says the car is the first practicable gasoline machine. He recommends that the Illinois Central make an appropriation for the construction of a car of similar design for use on short lines. The car is pronounced superior to an electric motor car in many ways, cost of operation principally. Similar experiments are going on in England and on the continent, with varying results.

EFFECT OF BANK RUN ON TELEPHONE SERVICE.—When the announcement was made of the defalcation of President Bigelow, of the First National Bank, Milwaukee, Wis., the service of the Wisconsin Telephone Company in that city was put to an extreme test. Shortly after noon the business began to increase, the unusual number of calls continuing until after 3 o'clock. The number of calls jumped from 300, which is the average during the busiest hour of the day, to 700, the result being that relief operators were called into service. The regular force was retained during the usual lunch hour, and two or three operators were placed at each board. Even then it was impossible to give normal service.

THE RÖNTGEN CONGRESS.—A cable dispatch from Berlin of April 29 says: "The International Congress, called to celebrate the tenth anniversary of the discovery of the Röntgen ray and to collate the latest applications and developments, opens here tomorrow, and will continue in session for three days. Prof. Röntgen will be present. The French representation will be particularly strong. Among the Americans announced to be present are Dr. Leonard, of Philadelphia; Dr. George F. Kunz, of New York, and Dr. Rudisjicinsky, of Cedar Rapids, Iowa. The latter's thesis is 'The Study of the Degenerative Processes of the Brain by the Röntgen Rays.' An exposition of Röntgen apparatus will be a feature of the congress."

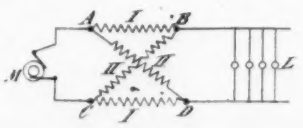
RÖNTGEN-RAY METER.—A patent granted to Mr. T. P. Hall, April 25, describes a device by means of which, it is claimed, both the intensity and the relative penetrating power of Röntgen rays may be measured. Two strips of tin and lead in foil form, each of a thickness increasing logarithmically from end to end, are placed adjacent to each other, and in front of a fluorescent screen. The strips are movable relatively to each other and to the screen. The two strips are so placed that the rays traversing both strips show with equal effect on both parts of the screen. The relative positions of the two screens serve to indicate the degree of penetration of the rays. For measuring the intensity of the rays, both strips are moved simultaneously, while the rays are passing therethrough, in a manner gradually to increase the thickness of the strips through which the rays pass until the rays are almost excluded from the screen. The position of the standard strips will then show the intensity of the rays.

PARKER ELECTRIC LAMP.—A novel form of incandescent electric lamp forms the subject of a patent issued April 25 to Prof. H. C. Parker. The light-giving portion of the lamp consists of granulated thorium oxide or carborundum tightly packed in a tube of quartz. In the ends of the tube is placed graphite of good conductivity, so that the terminals may connect with the main filling material and not be unduly heated. When the current is turned on the resistance offered by the body portion causes the latter to be quickly raised to a high heat, and to give off light according to its temperature. The quartz tubing will stand the most intense heat to which the resisting body is subjected in producing a light of high efficiency, and it has the transparent effect of glass.

ALTERNATING-CURRENT RECTIFIER.—A patent issued April 25 to Edwin H. Porter and Burleigh Currier relates to a novel construction of mechanical alternating-current rectifier. In its simplest form the rectifier consists of two transformers, each with a single primary and a single secondary coil. The two primary coils are connected in series across the alternating-current supply mains, while the two secondary coils are joined in series-opposition across the unidirectional-current delivery circuit. The two secondary electromotive forces would normally neutralize each other at each instant. By the use of proper shunting switches, however, first one and then the other secondary coil is placed on short-circuit, leaving the electromotive force of the other coil (in augmented form) active in the desired direction. The shunting switches, in the shape of commutator segments and brushes, are operated by a synchronous motor, so that the delivered secondary electromotive force remains always in one direction, although it fluctuates in value.

MARCONI AT CAPE BRETON.—A special dispatch from Halifax, N. S., of April 29 says: "Marconi is at present in Cape Breton watching the progress of the construction of the new wireless station. The station was originally built in sight of the ocean at Table Head, near Glace Bay, but it was determined that the station's proximity to the great works of the Dominion Coal Company might interfere with the matter of sending and receiving messages. The new station, which is four miles inland, is now in an advanced state of completion. It is built on the same principle as was the one on Table Head, only it is considerably larger and will be very much more powerful. The four towers, each about 210 ft. high, are surmounted with staffs several feet in length on top. At some distance out from the towers is a circle of eight spars, each 180 ft. high, and still another circle of fourteen spars a like distance out from the first circle. These spars will be connected with the towers by a network of aerial wires, which will concentrate in the operating rooms directly in the center of the square formed by the four towers. These wires are then grounded, trenches, which contain about thirty miles of wiring, radiating from the operating rooms."

ALTERNATING-CURRENT RECTIFIER.—A mechanical rectifier, without a commutator, is disclosed in a patent issued April 25 to Luigi Magrini, of Italy. The apparatus employs the advantageous features of synchronously varying impedances for causing the current to be selective in its behavior. A diagram of the circuits is given in the accompanying illustration. Between the alternator and the load are connected four choke coils, the impedance of which are varied synchrornously. During one-half of a cycle



the impedances of coils I are low, while those of coils II II are high, so that current passes readily from *A* to *B* and returns from *D* to *C*. During the other half of the cycle, however, the impedances of coils I I are high, while those of coils II II are low, so that the current passes from *C* to *B* and returns from *D* to *A*. Thus the current through the load circuit is unidirectional. For the purpose of varying the impedance, the coils are so arranged that their magnetic circuits may be opened and closed at the proper times by means of a synchronous motor.

Electric Lighting and Railway Construction in the Philippines.

UP to the present time electric light has been supplied in the city of Manila by a company known as "La Electricista," and while the service it afforded was in a measure satisfactory, still the power station was of antiquated type, filled with a large number of small machines generating curent at a high frequency, and totally unable to handle the business which came to it as a result of necessity. The replacing of this property by a modern system of power generation and distribution, brings to a close an extremely interesting piece of engineering in the Far East, and one that rendered necessary the overcoming of a number of obstacles natural to such an enterprise. In the same manner the tramway system of Manila has been electrified, and in place of the small, inefficient horse-car system formerly operated by the Campania de Los Tranvias de Filipinas, there is to-day a modern electric railway system, serving the city of Manila and its suburbs, together with several outlaying resorts and towns.

Recognizing the fact that for a city of 300,000 inhabitants, the transportation and lighting facilities of Manila were entirely inadequate, and that a reorganization and consolidation of these interests would find a profitable and constantly widening field, a careful in-

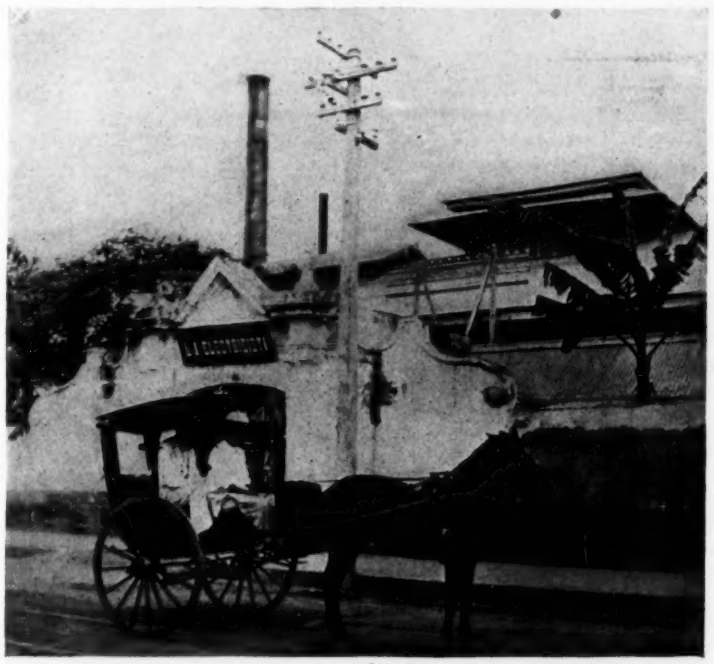


FIG. 1.—EXTERIOR OF POWER HOUSE, " LA ELECTRICISTA."

vestigation of the existing conditions and future possibilities was made by Mr. C. G. Young, construction superintendent of J. G. White & Co., of New York.

In view of the recommendations made in this report, financial interests, including the above company and others, took steps to secure franchises covering the reconstruction and extension of the lighting and power system, the electrification of the horse car lines, together with the steam line running from Tondo to Malaban, a town of 12,000 inhabitants, about 6 miles north of Manila on the Bay. The franchises were awarded to this company after public bidding, and immediately thereafter preparations were made to carry forward the project.

As an example of the care and foresight with which the report was made it may be stated that the entire system, as it stands to-day, has been erected almost exactly in accordance with the outlines prepared by Mr. Young, no changes of importance having been made. The idea has been to supply power for both railway and lighting purposes in one station, designed to generate this power in the most economical manner, considering all of the elements which necessarily enter into the design and operation of such a station. This fact was in a large measure responsible for the fact that power is generated by four large turbo-generators, half of it being transformed in the same station into direct current at 600 volts. This, it will be seen, permits of the use of a relatively small number of turbine-driven units, resulting in a high thermal and electrical efficiency of the plant—the direct generation of both alternating and direct current with a corresponding increase in the number of machines, complexity of apparatus, and decrease in size of units, reducing the station efficiency. As will be seen by reference to the plan of the station, provision has been made for the installation of additional

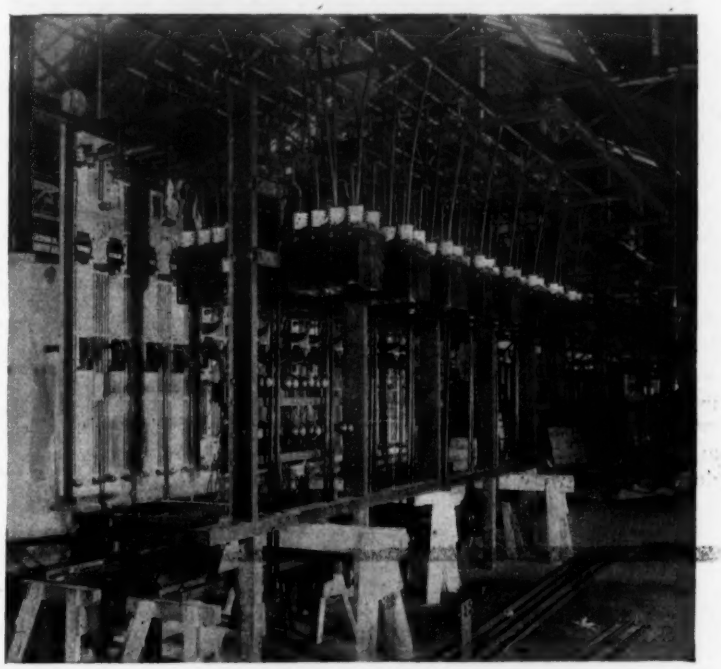


FIG. 2.—REAR OF HIGH-TENSION SIDE TRANSFORMER PANELS AND FEEDERS.

boilers and generating apparatus at either end, the result being in keeping with the symmetry of the present arrangement. The original plans called for the installation of three 750-kw turbo-

FIG. 3.—STREET IN MANILA, SHOWING TYPICAL POLE LINE CONSTRUCTION, ARC LAMP AND OLD TRACK OF "TRANVIAS DE FILIPINAS."

generators, and space was left for a fourth set of 1,500 kw capacity. The demand upon the station has already necessitated the installation of this unit, and at the present rate of increase of business, a second of the same capacity will soon be required.

For the past 10 years a company known as "La Electricista" has

supplied current for lighting purposes in the city of Manila. This company was owned and operated by Spanish residents of Manila, and in spite of adverse conditions managed to give fair service, although the station capacity and distributing system were entirely inadequate to supply the demand. The franchise required current to be furnished for both arc and incandescent lights for illuminating the streets of the city, the light being required to burn 12 hours per night. The average night load required by the city was 120 kw for incandescent lamps, and 100 kw for arc service. In addition to this, over 700 kw, both arc and incandescent, was sold at varying rates.

Flat rates for stores and houses averaged from 8.7 to 16.9 cents Mexican (a Mexican dollar being worth about 50 cents American money) per candle-power per month, depending upon the length of time used daily. The 16-cp. rate is from $1.20 to $2.45 Mexican per month. Arcs of 1,500 cp vary from $12 to $18 per month and 2,000-cp. arcs from $14.50 to $23 per month Mexican, according to the time used. Meter rates were 30c. Mexican per kw-hour. Customers were required to pay for all meters at the following prices, Mexican: 5 amperes, $65; 10 amperes, $70; 20 amperes, $85; 25 amperes, $90.

The customer also paid $1 Mexican for each arc lamp installed and 20 cents Mexican for each lamp renewal. About 18,000 incandescent lamps were used.

The power plant (Fig. 1) is of wood frame, with galvanized iron roof; the boiler room is open on three sides for better ventilation. Steam was generated in six 200-hp Manchester-Galloway boilers installed in 1894; four 250-hp Babcock & Wilcox boilers installed in 1901, and two 80-hp Buckeye boilers, the average pressure being 110 lbs. Feed water was taken from the city mains at a cost of 90 cents per 1,000 cu. ft., and water for condensing was taken from a canal at a temperature from 82 degs. to 86 degs. Fahrenheit. The engine room contained two 450-hp cross-compound Buckeye engines, rope connected to two 300-kw. single-phase General Electric generators, 133 cycles, 2,300 volts; six 300-hp tandem compound Buckeye engines, connected in pairs by jaw clutches to each end of three sets of shafting, to which ten 60-kw Brush alternators and the same number of exciters were belted. The total station capacity may be summed as follows: Boilers, 2,200 hp; engines, 2,700 hp; arc generators, 1,200 kw; arc dynamos, 312 series direct-current lights.

The feeders were carried on iron poles, which, however, proved to be unsatisfactory unless they were very carefully erected and every precaution taken to prevent the rapid deterioration of metal due to the moist climate.

The new power station of the Manila Electric Railway & Lighting Company is a steel and concrete structure, located on a large island in the Pasig River, practically central in regard to the territory which it will serve. The Pasig River furnishes a waterway to the ocean, making it possible to deliver the coal, which is brought from Japan and Australia, directly to the power house by lighters.

The main building consists of an engine room and a boiler room. The former is 47 ft. by 170 ft. and 25 ft. high, with a basement 12 ft. in height. The boiler room is the same length and 54 ft. wide, its floor being on the same level as the basement floor of the engine room. The frame of the power house is of structural steel, consisting of columns, roof trusses and purline. The walls of the engine room are of poured concrete, while the roof and floor are concrete slabs. The boiler room has corrugated iron sides and roofing. The siding, however, extends only to within 12 ft. of the ground, the open construction being necessary in order to gain ventilation in this climate. The windows are set in steel frames, the sashes being made of native hardwood.

Owing to the softness of the soil, the foundations are laid on piles driven to an average depth of 20 ft. to a hard sand stratum. The tops of the piles are covered with a 2½-ft. concrete mattress. The foundations for engines and all heavy machinery are also set on piles.

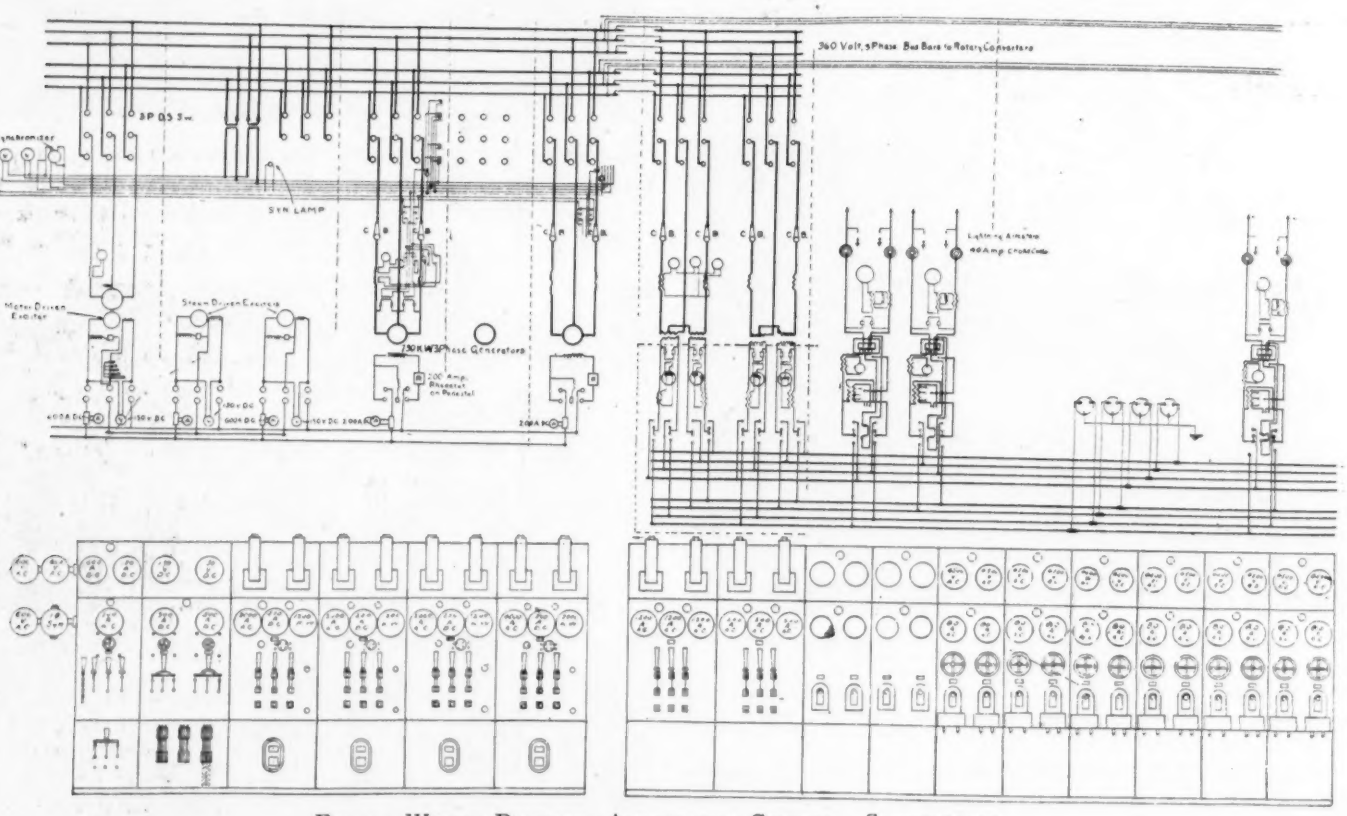


FIG. 4.—WIRING DIAGRAM, ALTERNATING-CURRENT SWITCHBOARD.

The boiler equipment consists of eight Babcock & Wilcox boilers rated at 400 hp each. The boilers are arranged in two batteries, of four each, on either side of a self-supporting steel stack 175 ft. high. The stack is lined its entire length with firebrick, and has two nozzles to which the smoke flues are connected. These latter are of steel and of the buggy-top style. Steam is generated at 200 lbs. pressure, and is superheated to 600 degrees. The arrangement of the boiler room, as well as of the engine room, is such that future expansion can take place symmetrically on either end. The boilers at present are provided with flat grates, although provision has also been made for a possible future installation of stokers.

The coal is brought from Australia and transferred, in the harbor of Manila, to barges having a capacity of from 200 tons to 300 tons. These barges being brought alongside of the power house, the coal is unloaded by means of a radial gantry crane, which has a capacity of 50 tons per hour. It is either deposited in open air storage or delivered by the crane directly to the boiler room. The construction of this crane, and the ample coal storage space provided for its

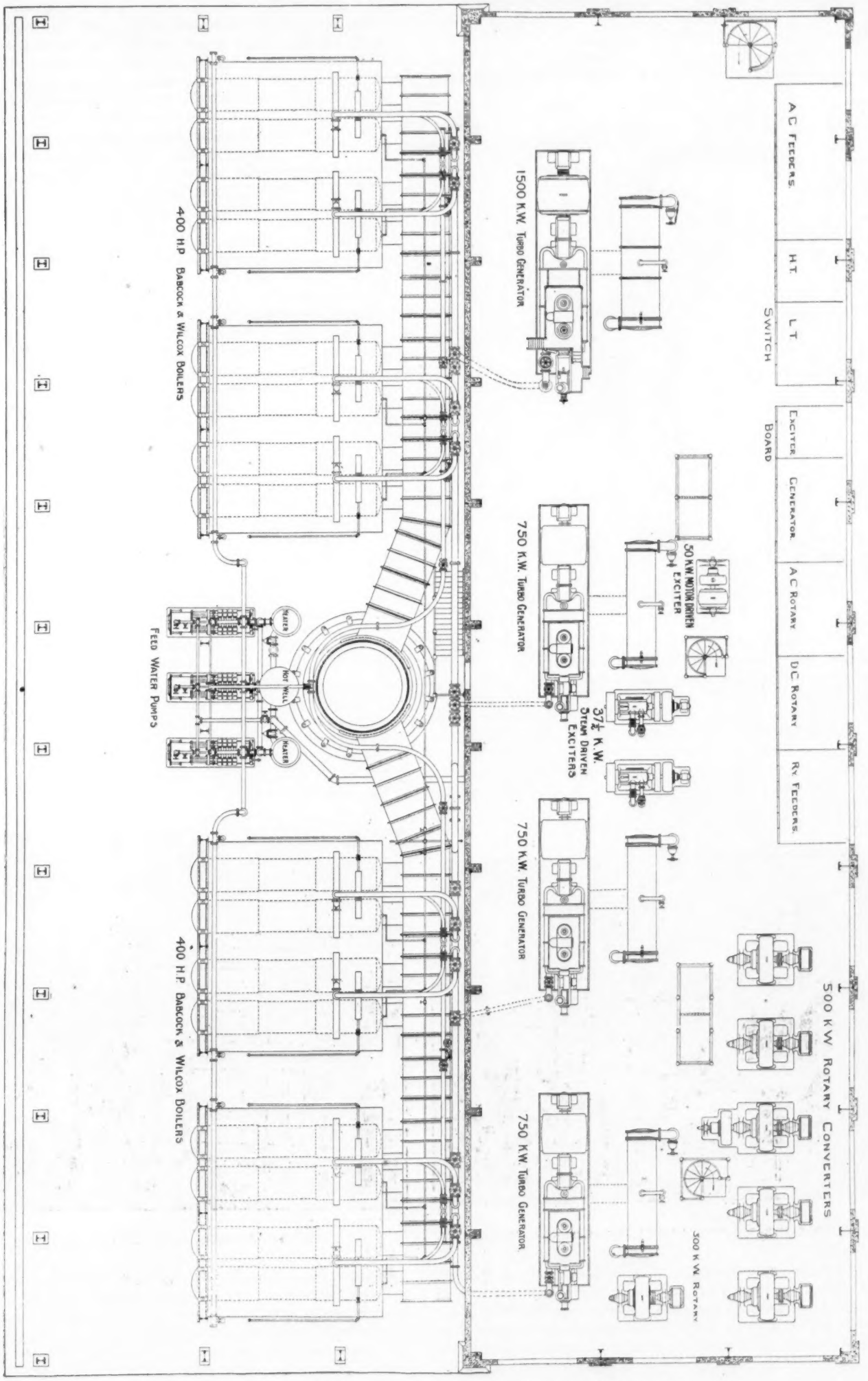


FIG. 5.—PLAN OF POWER HOUSE, MANILA ELECTRIC RAILROAD AND LIGHT COMPANY.

use, are illustrated in the diagram shown in Fig. 6. Coal is delivered at the boiler for approximately $5.75 per long ton, and is guaranteed to contain 13,000 B. T. U. per pound.

Water for the condensing plant is taken through a concrete intake 3 ft. by 11 ft. extending to the Pasig River on one side of the island,

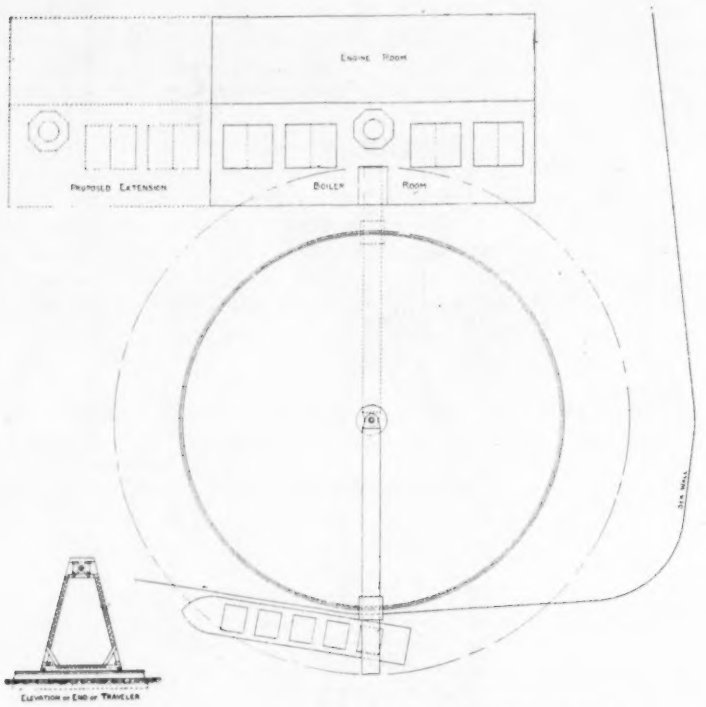


FIG. 6.—RADIAL GANTRY CRANE.

and is discharged through a tunnel built from the power house to the opposite side of the island. Air-blast ducts have been provided for the boilers, as at some future time it may become necessary or advisable to install a forced draft system.

Three 15-in. double-suction centrifugal pumps, each connected to an 8½-in. by 8-in. Westinghouse engine, and having a capacity of 7,000 gals. per minute, discharge the condensing water into a main header, which distributes it to the condensers. Each condenser has a hot-well pump automatically operated by a float, the hot wells being located under the condensers.

Feed water is obtained from driven wells, and is raised by means

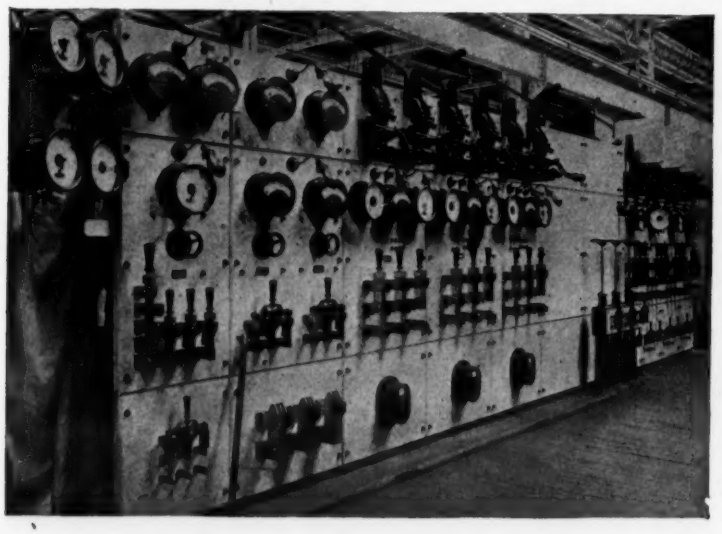
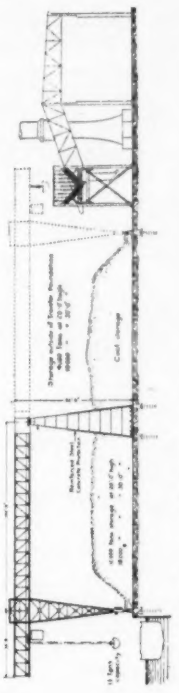


FIG. 7.—EXCITER, GENERATOR AND ALTERNATING-CURRENT ROTARY BOARDS.

of compressed air into a standpipe 14 ft. in diameter by 60 ft. high, which is located at one end of the boiler house. Condensed steam is delivered by the hot-well pumps to a steel hot-well located in the boiler room immediately in front of the stack; here it joins with the make-up water taken from the standpipe, and is fed by gravity through feed-water heaters which are of the closed type, to the feed-pump suction. Each boiler is provided with a Metropolitan double-tube injection. The feed-water heaters have a total capacity of 1,500 hp. From the boilers superheated steam is distributed through an 8-in. main header mounted on substantial structural brackets on the boiler room wall. From the header, connection is made to the turbines through a steam line passing under the engine room floor. All fittings on the high-pressure lines are of cast steel, and the valves are provided with nickel bronze seats and discs. All drains from the steam lines are returned to the boiler by means of a Holly gravity system. The steam from the 750-kw turbines is condensed in a 3,000 sq. ft. Allberger surface condenser, located on the engine room floor. The 1,500-kw turbine is connected to a 6,000 sq. ft. condenser of the same type.



In the engine room are located the following apparatus: Three Westinghouse-Parsons 1,000-hp turbines, direct-connected to three 750-kw turbo-generators. The turbines will be operated at 200 lbs. pressure, with a vacuum of 27 in., at a speed of 1,800 r.p.m. The generators will be three-phase, 370 volts, 60 cycles. One 2,000-hp turbine, connected to one 1,500-kw generator, as above. This machine is now being installed. Three 500-kw rotaries, 370-600 volts; one 125-kw booster, direct-connected to one of the above rotaries; four 250-kw oil-cooled transformers, 360-3,400 volts, 60 cycles; two 500-kw transformers, 360-3,400 volts, 60 cycles; one 50-kw motor-driven exciter; two 37½-kw steam-driven exciters.

The switchboard consists of 44 panels and extends along one side of the engine room. It is 105 ft. in length, all bus-bars are in duplicate and several spare panels provide for any accidents that are likely to occur. At the extreme left of the switchboard are located three exciter panels controlling one motor-driven and two steam-driven exciters. Swinging brackets intalled on end of the exciter board carry three bus-bar voltmeters and a synchronscope. Next to this are arranged four generator panels, together with one spare panel for the second 1,500-kw generator. Immediately in front of the generator panels are located the pedestals from which the generator rheostats, located in the basement, are operated. Adjacent to the generator panels is the low-tension transformer board. This

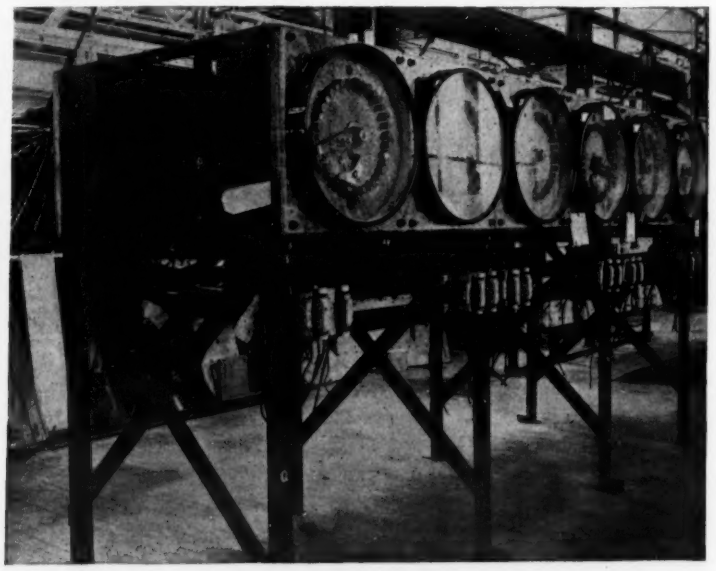


FIG. 8.—REGULATORS IN BASEMENT.

contains the two panels controlling the low-tension side of the four 250-kw transformers, T-connected in sets of two. Taps are brought out from the secondary windings of these transformers, as shown in Fig. 4, to form the Scott three-phase—two-phase connection with a secondary pressure of 3,400 volts.

The high-tension side of each bank of transformers is controlled by two 3,400-volt, two-phase panels, so arranged that they may be

operated on either side of the duplicate two-phase bus-bars. These panels are equipped with ground detectors and levers for distant controlled oil switches. There are also two additional transformer panels for controlling the low and high-tension sides of the two 500-kw transformers. These are operated in parallel with the smaller transformers on the same bus-bars. At the right of the transformer board are located six feeder panels controlling as many two-phase lighting circuits. Each of these panels is provided with indicating instruments and distant control apparatus for the voltage regulators. Thirty-four-hundred volt, four-pole, double-throw, oil switches, allow of connection to either of the above mentioned high-tension bus-bars. Each outgoing circuit is protected by its independent "low equivalent" lighting arrester, mounted in the basement directly under the feeder panels at a point where the outgoing lines rise to the wall outlets. At the right of the transformer board are located panels for controlling the alternating and direct-current ends of the rotary converters, used for converting the 370-volt alternating current into 600-volt direct current for distribution to the street-railway feeders.

On account of the high average temperature of the atmosphere it was found necessary to use a larger quantity of copper throughout the entire installation than would be required in the same system in the United States. That the temperature is a considerable factor in the design of electrical machinery and installation is shown by the fact that approximately 50 per cent more copper is used throughout the bus-bars than in a similar installation in the United States. All copper conductors, such as bus-bars, operating under full load, are so designed that the current shall not exceed 800 amperes per square inch. All stationary connections are figured at 150 amperes per square inch of contact area, and all movable contacts 60 amperes per square inch.

Connections between the various parts of the board and the machines are made with paper-insulated, lead-covered cables, containing a relatively liberal amount of copper. All such cables are carried in the basement under the generator room, either suspended in racks or in conduit laid in the basement floor. Every precaution has been taken to prevent short circuits in the cable runs, or on the switchboard, and separating plates are freely used. The overhead circuits are carried on 30-ft. wood poles, wherever the streets are wide enough to permit of this construction. Ipil, a native hard wood, dark and dense in structure, is used for the poles, which are set in concrete. This construction has proved quite satisfactory. Many of the streets within the "Intramuros," or walled city, are 25 ft. or less in width, and in these the feed wires are carried on tubular composite poles. Each pole consists of vertical four-inch pipe, set into iron pipe sockets on either building line, and connected at the top with a third section of pipe. Wooden cross arms are clamped to this last, and side braces are introduced to strengthen the structure.

Current for lighting purposes is metered, the charge being 20 cents per kw-hour.

A Convenient Form of Oscillograph.

BY F. A. LAWS.

WITH the progress of alternating current electrical engineering, many problems have arisen which require for their solution the delineation of the forms of the current and potential waves. Consequently, there has been a widespread interest in methods for determining wave forms. Formerly such determinations were very laborious, and as the curve had to be mapped point by point, the field of usefulness of the various methods was a restricted one. Experience showed that point-by-point methods and those based on the average wave were inadequate, for many of the phenomena to be investigated were transient in nature, and it was out of the question to so arrange the apparatus that the whole cycle of the phenomenon could be repeated ad libitum.

Blondel, by a clear understanding of the conditions which must be met by any successful instrument which is intended to record transient phenomena of very short duration, and by the practical introduction of galvanometers of high period with aperiodic damping, to which he gave the name of oscillographs, rendered it possible to record such phenomena, and thus gave the means of studying many questions not hitherto susceptible of experimental examination.

No laboratory of electrical engineering can now hope to give adequate instruction even in the elements of the subject without some form of oscillograph.

In 1901 the electrical engineering department of the Massachusetts Institute of Technology purchased the form of instrument then available, that designed by Duddell. This was used for special inves-

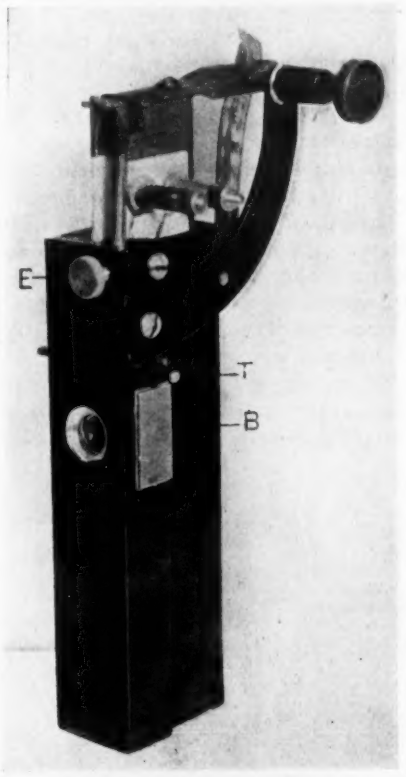


FIG. 1.—COMPONENT ELEMENT.

tigations, but had certain faults which prevented its general use by students, namely, extreme delicacy and the difficulty of making repairs in case the strips burned out or failed, as they occasionally will, for

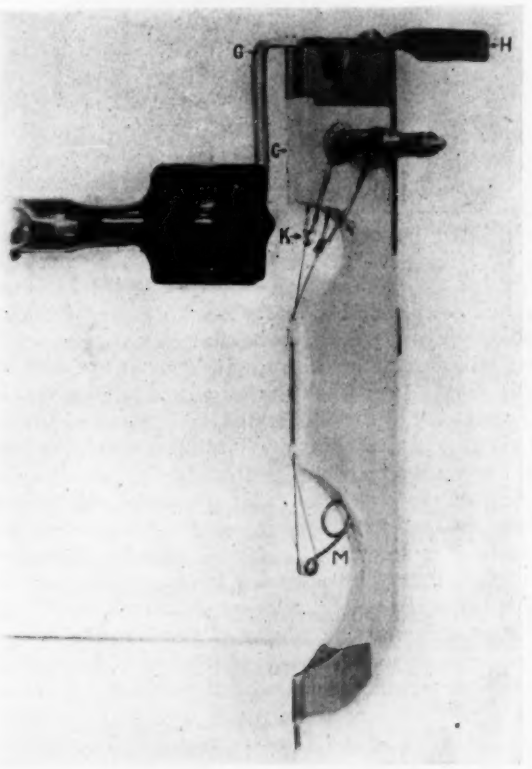


FIG. 2.—VIBRATOR.

no apparent reason. As it was out of the question to do without the instrument, in 1902 experiments were made with the view to developing a more suitable arrangement. The first instrument was of the

Blondel type, the moving part being a flat strip of magnetic material vibrating torsionally. For use in a crowded laboratory, and where the failure of a single instrument may mean the disarrangement of the work of a considerable number of students, this form has much to commend it, for the risk of a burnout is practically nil; on the other hand it has a serious defect, namely, considerable inductance which precludes its use in many cases. Consequently, the oscillograph here described was constructed and has proved so serviceable during the past year and a half that the design is given with the hope that it may be of use to others who are confronted with the same problem. The instrument was built at the Lowell Laboratory of Electrical Engineering by the mechanician, Mr. H. W. Webber.

The requirements are: A very strong magnetic field, in order to obtain sensitiveness while retaining a high free period of vibration; a high carrying capacity of the vibrating strip; ease in making repairs; convenience of adjustment and the ability to make visual observation or photographic records at will. In this latter connection a shutter which will expose the film for one revolution of the photographic drum is necessary. These, of course, are matters of mechanical design, but unless they are properly attended to, while the instrument may be suited to a physical laboratory, it will not be one which is generally applicable to engineering work.

The most important part of the apparatus is the vibrator. A complete element is shown in Fig. 1, and the vibrator itself in Fig. 2. The containing case is constructed as follows: A piece of brass is first milled transversely and the soft iron pole piece, *B*, sweated in. The piece is then milled out lengthwise with a V cutter to the depth of the iron and the groove bottomed out with a 3-32 milling saw, the case being then completed by the addition of the bottom and sides. At the bottom of the groove a centre is provided upon which the foot of the ivory piece that carries the vibrating strip may swing. It will be seen that the form of the cross section of the ivory and the groove in which it rests are such that the strip cannot be injured mechanically, for the bottom is centred and the top, *C*, rests in the groove and is held there by the upper centre carried by the arm *G*. To remove the vibrator it is necessary simply to loosen the thumb nut, *E*, and draw the vibrator up. There is no danger of breaking the strips for the groove is perfectly smooth. Lateral adjustment of the spot of light is provided by a screw which is fastened to the case and bears against the arm *H*, which is forced against it by a spring. Vertical adjustment is effected by tilting about the trunnions, *T*. This motion is controlled by a screw bearing against the case. The strip is soldered to the loops, *K*, which are of soft copper wire, soldered in turn to the binding posts. The necessary tension is provided by the spring, *M*. It will be noted that when the instrument is set up the entire length of the strip is immersed in the damping oil with a consequent increase of carrying capacity. As the instrument is intended primarily for use in laboratory classes, it has been made very robust. We have employed suspension strip such as is used in the Sullivan marine galvanometer, and have been content with a moderate sensitiveness. The free rate of vibration of the system is about 6,000 complete periods per second. If a strip gives out, the renewal is a matter of but five minutes.

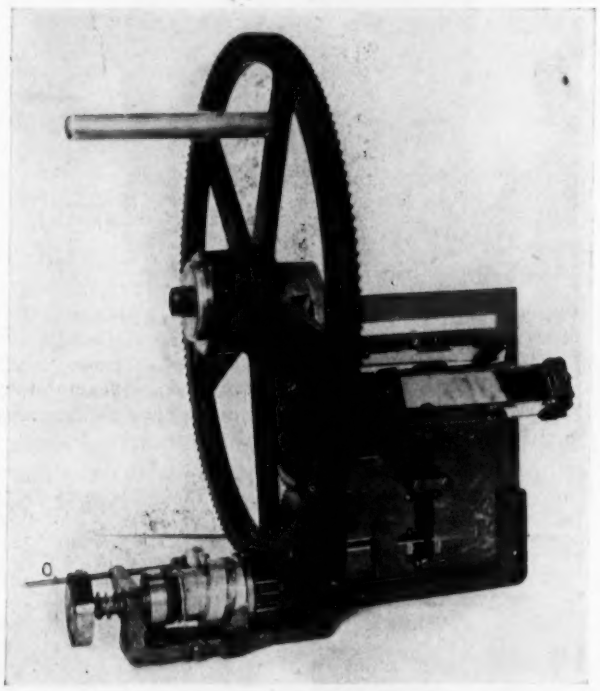


FIG. 3.—ROTATING MIRROR.

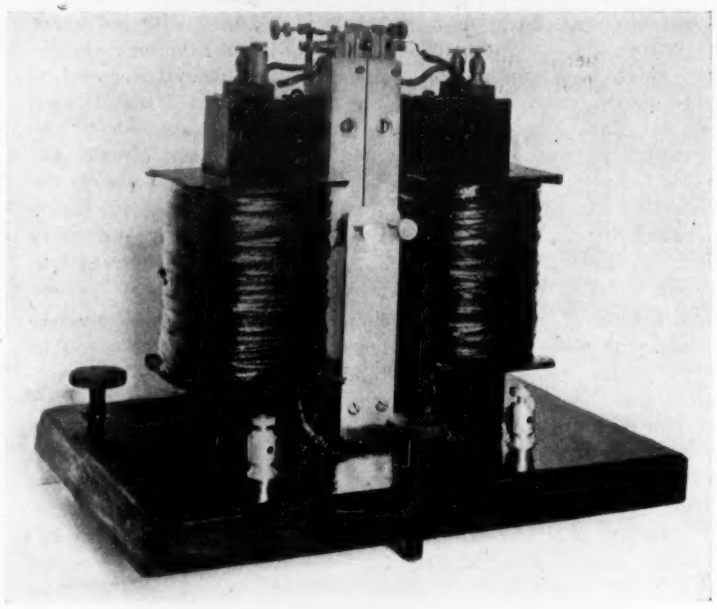


FIG. 4.—OSCILLOGRAPH.

For visual observations we have adhered to the usual arrangement of a rotating mirror which throws upon a ground glass screen the spot of light which has been directed upon the mirror carried by the shutter drop. This part of the apparatus is shown in Fig. 3. The shutter has two drops; when that at the front is sprung the shutter opens, and it is closed by the falling of the one in the rear. It will be noted that the shutter may be set without exposing the film. When set, the drops are held in position by two little feet which rest on the rod *O;* if this is withdrawn, which is done by a quick acting screw thrown into gear by a friction clutch, the shutter operates. The offset of the feet and the pitch of the screw are such that the exposure is for one revolution of the drum. The friction clutch is operated by the pressure of the foot. If so desired the shutter may be operated by hand, the catch being raised out of the screw thread.

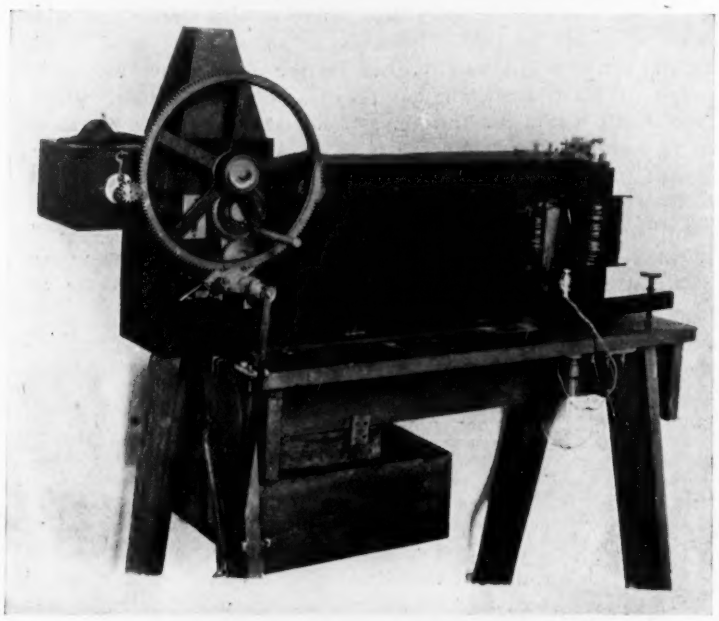


FIG. 5.—APPARATUS COMPLETE.

For our purpose it has usually been sufficient to turn the drum by a hand wheel, though, of course, a synchronous motor is used at times, being coupled to the drum by a pin clutch.

The complete instrument is shown in Fig. 5, and the oscillograph itself in Fig. 4.

General Electric Single-Phase Railway.

As stated in the issue of the ELECTRICAL WORLD AND ENGINEER for March 25, a single-phase railway system has been placed in active operation between Pontiac and Odell in Illinois. This is a section of the Bloomington, Pontiac & Joliet electric railway, the first system in this country to be opened for the public, operated exclusively by single-phase currents. We are able to give below a few of the details not covered in the previous article.

At the present time only one car is in operation, but in the near future others will be put into service. The car is furnished with four 75-hp motors, each designed to work at a pressure of 200 volts, the four motors being connected permanently in series with all of the field coils on the ground side. The field windings and core are self-contained, and entirely independent of the motor housing. The housing is split and bolted together so that it is an easy and inexpensive operation to renew the field parts should they become damaged.

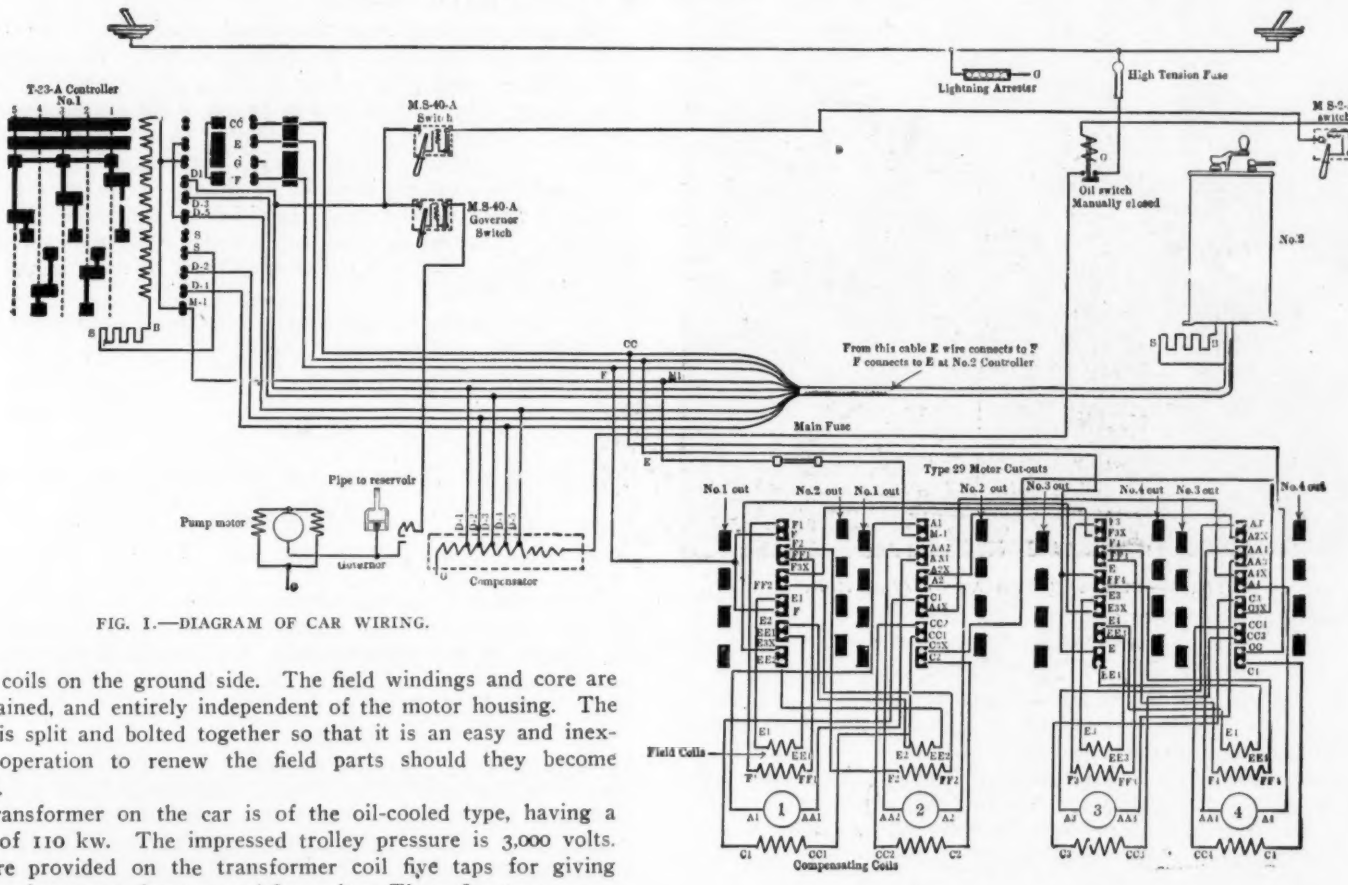


FIG. 1.—DIAGRAM OF CAR WIRING.

The transformer on the car is of the oil-cooled type, having a capacity of 110 kw. The impressed trolley pressure is 3,000 volts. There are provided on the transformer coil five taps for giving pressures of 400, 500, 600, 700 and 800 volts. These five taps correspond with the five notches on the controller dial plate, so that each notch constitutes a running point. See Fig. 1. To prevent the motorman from leaving the handle between points and thereby burning the fingers by short-circuiting two sections of the compensator, a small section of resistance is interposed during the moment of transition from point to point. Each finger of the controller is provided with a separate blowout, all of the coils of which are connected in series with each other and with the transition resistance, so that current flows through them only when the controller fingers are passing from point to point, and from the first point to the "off" position. Cylindrical cutout switches are provided, so that any one motor may be disconnected when desired.

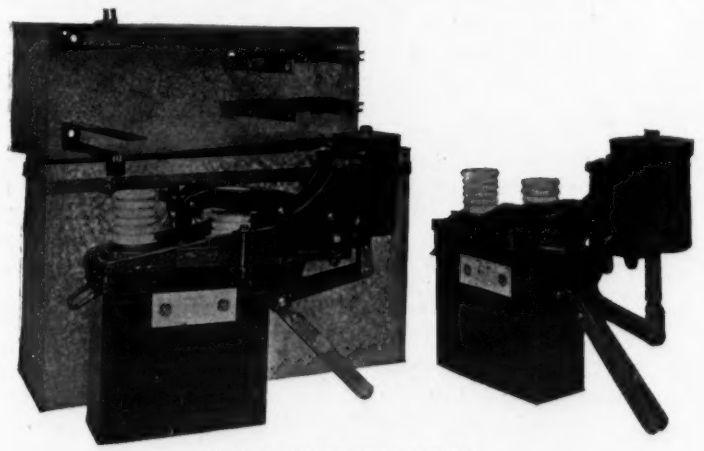


FIG. 2.—MAIN OIL SWITCH.

The main oil switch, illustrated in Fig. 2, is closed by hand, and held in this position by a retaining coil energized from the 400-volt tap of the transformer. A retaining coil switch is situated in each cab, and is in series with this circuit, with the result that the main oil switch is thrown by opening either retaining switch. The retaining coil is designed automatically to release and open the oil switch should the voltage drop to half its normal value. The high-tension circuit is protected by a fuse of the expulsion type mounted on the roof, while the low-voltage circuit is protected by a copper-ribbon fuse placed in a magnetic blow-out fuse box. All of the auxiliary circuits are protected by cartridge fuses.

The interior of the car is handsomely finished in cherry. The seats have high backs, and are upholstered with green leather. There are sixteen seats in the main compartment, while the smoking compartment is provided with seats of the longitudinal type; a hot-water heating apparatus is installed in the smoking compartment, but this can be removed in summer and make room for another seat. The weight of the car complete is about 29 tons. The headlight is a 25-cycle arc lamp which is connected in series with the incandescent lamps used for illuminating the interior of the car. This headlight is causing no trouble whatever.

As seen in Fig. 3, the trolley wire is supported by a catenary construction. Both the trolley and the catenary carry current. There are two trolley wires running parallel with each other, separated by a distance of 7 in.; extra holes are drilled in all of the wooden brackets to permit this distance to be varied if desired. Each trolley is of No. 00 grooved copper wire, and the catenary consists of a stranded cable of 3/8 in. in diameter, there being seven strands of No. 11 steel wire. This arrangement of duplicate trolleys not only eliminates all the switching complications, but also obviates the use of extra feeders.

At the present time the trolley is supported from the catenary at intervals of every 100 ft. by mechanical clips of malleable iron, made in two parts and provided with hooks which slip over the catenary cable; these hooks are hammered down to prevent the possibility of their becoming loose. It has not yet been decided whether the trolley will ultimately be supported from the catenary at intervals of 100 ft. or 10 ft. There are arguments both for and against each arrangement. Although the construction is such that little trouble is antici-

pated from a broken trolley, such contingencies have to be considered. Should a break occur in a trolley supported only at every 100 ft., the broken ends in falling to the ground would be likely to cause a short-circuit sufficient to throw the overload switch in the power house and the line would then remain dead until the fault was remedied. But, on the other hand, were the broken trolley supported every 10 ft., the free ends will be more likely to be dangerous to life and property, due to the fact that no short-circuit would occur, and the possibility of persons on the line forming a short-circuit through their bodies by coming in contact with the hanging wire would be increased. The poles are 35 ft. in length, are buried in the ground to a depth of 6 ft. and are 7 in. in diameter at the top. They are spaced at a distance of 100 ft. apart. The trolley is supported 19 ft. from the ground. For supporting the catenary, 5-W Thomas high-tension insulators are used, which were subjected to a severe test before shipment. Details of these insulators are given in Fig. 4. They are supported on malleable-iron pins and attached to the same by means of Portland cement.

FIG. 3.—VIEW OF OVERHEAD CONSTRUCTION.

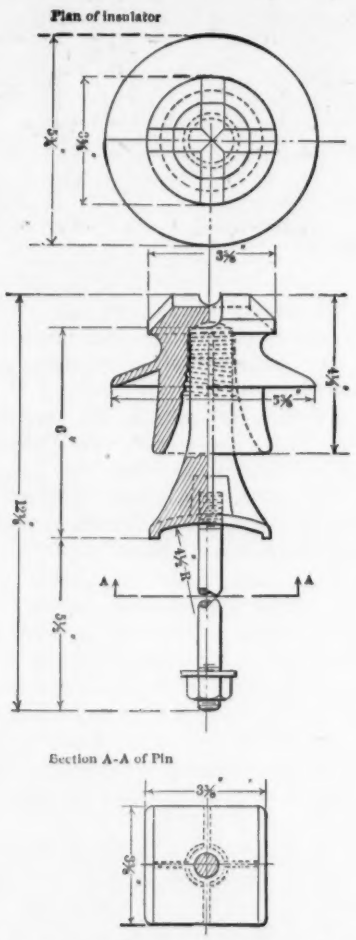


FIG. 4.—DETAILS OF INSULATOR.

The poles are placed at a distance of 7 ft. from the center of the track. The brackets are of Washington fir, 7 ft. 9 in. in length, and have a cross section of 3 in. by 5 in. They are supported by wooden knee braces with a section of 3 in. by 3 in. The brackets and braces are held together and both are attached to the pole by means of malleable-iron castings. The trolley is anchored every 2,000 ft. All strain and guy wires are insulated by means of strain insulators, consisting of impregnated hickory, furnished with malleable-iron heads and eyes. These are 24 in. in length, and were manufactured by the General Electric Company; they are similar to those in use on the Schenectady-Ballston line.

The General Electric Company is responsible for the entire electrical equipment of the line. The Arnold Company acted as consulting engineers for the system.

Meeting of American Institute of Electrical Engineers.

At the meeting of the American Institute of Electrical Engineers on April 28, the four papers presented dealt with the general subject of instruments and measurements. Abstracts of three of the papers and of the discussions following their reading are given below. The paper by Mr. W. J. Mowbray on the "Maintenance of Meters" will be printed in full in our next issue.

The paper by Mr. J. D. Nies treated the requirements for meters on polyphase circuits and outlined the defects existing in meters as ordinarily constructed. The errors attending the use of instrument transformers with meters of large capacity are attributable to the local impedance of the coils of the pressure transformer, and to the magnetizing current in the current transformer. The secondary electromotive force of a pressure transformer is less than the value obtained from the ratio of transformation by an amount varying with both the value and the power factor of the load. Perhaps the best that could be done would be to make the ratio correct at half load. The phase error introduced by a shunt transformer represents an apparent decrease in the angle of lag of the system of perhaps one-half degree.

The use of the series transformer introduces two errors: the quantity of the secondary current is too small, and the phase of the secondary is different from that of the primary. The effect of both transformers is, therefore, to produce an alteration in the apparent phase of the current in the direction of lead. On this account a lagging current registers in the meter with a reduced angle of lag, while a leading current registers with an increased angle of lead.

The author considered the different methods of applying induction meters to the measurement of polyphase power. No method which employs one single-phase meter is accurate unless the load is in perfect balance. The method in common use, which employs two separate single-phase meters with their current coils connected in two of the wires, and their pressure coils placed across between these wires and the third wire, although giving results which are theoretically correct, has practical disadvantages when used on circuits where the average power factor is low. To give correct readings on circuits in which the power factor goes below 50 per cent, the meters must be able to register as accurately when running backward as when running forward. Any meter which is provided with a friction compensating device is debarred from consideration for this particular service. A better method consists in combining the two meters so that both moving elements are attached to the

same shaft. The fact that both meters are combined into a single unit, however, increases the difficulty of calibration.

It is suggested that the best plan would be to employ three separate single-phase meters, one for each phase of the circuit, having three pressure coils connected in star, the junction point of which is connected to the neutral formed by a star connection of the secondaries of the pressure transformers.

In his paper on "The Oscillograph and Its Uses," Mr. Lewis T. Robinson stated that instruments for obtaining wave forms divide themselves naturally into two classes; those employing point-by-point methods, used only with recurring waves, and continuous methods, which show either recurring waves or record individual waves. The first class can be traced to a common origin in the point-by-point method of Joubert, and the second to the vibrating coil device of Elihu Thomson and to his later apparatus and that of Frölich, for observing the excursions of a telephone diaphragm acted upon by the current of which the wave form is to be investigated.

The Joubert method involved the use of a contact device which could be mechanically so placed as to cause an indicating instrument to register the potential at various points along the wave. The early device of Thomson (1881) was a crude form of oscillograph using a powerful electromagnet in the field of which was mounted a small, light coil through which were sent the waves to be investigated. By means of a system of levers a fine analine pencil traced a curve on a sheet of paper carried on the cylinder of a chronograph. The later device of Thomson and that of Frölich (1887-1889) employed a sensitive plate to record the wave form. In front of a magnet pole was placed a telephone diaphragm to which was fastened a very light lever, which in turn was attached to a small pivoted mirror, a spot of light from which was thrown upon the sensitive plate.

Modifications of the Joubert method are embodied in Hospitalier's ondograph, in Rosa's curve tracer and in the General Electric wave meter. In the ondograph the record is obtained by an inking pen on a revolving drum. The actuating part of the recording instrument is traversed by the discharges from a condenser. The condenser is charged from a revolving contact which, by an ingenious method of gearing, is automatically changed with reference to the poles of a synchronous motor, thus producing on the surface the desired record of the wave. In the Rosa curve tracer the record is obtained on a drum by printing automatically from a potentiometer contact which is set by hand to a point indicated by a zero reading on a galvanometer. In the General Electric wavemeter the record is obtained on a photographic plate from a galvanometer receiving the discharge from a condenser, which is charged and discharged continuously by means of a commutator and a contact brush attached to a synchronous motor, which is, in turn, electrically connected to the circuit under test.

The major portion of the paper is devoted to a description in detail of the two types of oscillographs due to Blondel (1893). The moving iron type consists of a thin ribbon of iron stretched between the pole tips of a powerful magnet, thus forming a polarized needle, held in position by the directive force of the magnetic field, and also by the resistance to torsion of the strip itself. Two small coils, to which the circuit under investigation is connected, are arranged on either side of this strip in such a way that the strip is acted on by the current flowing in them, and at any instant the strip, having the necessary high period of vibration and critical damping, takes up a position which is a measure of the current flowing in the coils at that instant. A minute mirror is attached to the middle of the vibrating strip, for the purpose of causing a beam of light to record the motions of the strip. The vibrating loop type of oscillograph is in reality a D'Arsonval galvanometer in which two small metallic bands constitute the moving coil, as well as the suspensions. These are located in a strong magnetic field, and the varying current to be investigated is led through the strips in opposite directions. A small mirror attached by its edges to the middle portion of the strips serves to indicate the movement of the strips. Numerous photographic reproductions of records from the oscillograph are given as showing the field of usefulness of the instrument.

The paper by Mr. F. P. Cox on "The Use of Instruments on Switchboards" was intended to invite discussion on what seems to be the more important features of instrument engineering. In determining upon the capacity of the instruments to be used, present needs cannot be altogether overshadowed by possibility of future growth. It is generally considered advisable on railway circuits to have considerable overload capacity, and but little attention is paid to the light load period. On lighting circuits, however, the overload is not considered to be as important as on railway circuits, and the light load is given more attention. The needle of an indicating instrument should normally rest between one-half and two-thirds scale. Integrating instruments should be fully loaded under normal conditions, for they have an inherent overload capacity not possessed by indicating instruments.

Too little attention has been given in the past to providing suitable arrangements for calibration. The errors due to stray fields may be eliminated almost entirely by properly shielding the instrument, and no error need be introduced on account of residual magnetism or hysteresis of the iron shield. The added security for the operators and the added convenience in removing or cutting out instruments for recalibration more than compensate for the slight errors introduced by the use of series transformers. In inserting meters in polyphase circuits the greatest care should be taken to see that the instruments are installed exactly in accordance with instructions from the manufacturer. Instruments are not infrequently charged with errors which should properly be attributed to incorrect connections.

President Lieb, in opening the discussion of the papers, called attention to the fact that there is a considerable variation as to requirements which can be imposed upon, and the results which can be obtained in, a meter test on a customer's premises, as compared with a test in the laboratory. A meter should be tested under the conditions and in the location in which it is used. In regard to the proper ratio of meter capacity to installation, it should be noted that, if the ratio be taken as unity, under the conditions of heaviest load on the system, the average load on the meters will be only about 30 per cent of the meter capacity. During the months of light load and during the periods of the day when the loads on the meters are of comparatively little moment, the average of the loads will be considerably under 10 per cent of the rated capacity. The unsatisfactory results from operating meters on so low a percentage of their capacity are well known. It is considered good practice, in usual metering operations, to so proportion the ratio of meter capacity to installation that some meters will be burned out. It would be safe to say that a supply system, in which there were no meters that burned out, used an excess of meter capacity, and that the number of meters that burned out furnishes a rough indication as to whether an economical policy is being pursued in the selection of the capacity of the meters.

Mr. Carl D. Haskins referred to the valuable information contained in the report of the Board of Gas and Electric Light Commissioners of the State of Massachusetts. A law of the State provides that a consumer who complains that his supply meter registers incorrectly may have the meter tested, without cost, if the meter is wrong, and at a nominal fee, if the instrument is sufficiently correct. The law prescribed that consumers could have a certain amount of money refunded to them if the meter erred beyond a certain amount. In the year 1904 the amount of money refunded was $4.50, while the State collected $138 from the same group of people who got $4.50 back.

Prof. Edward B. Rosa mentioned the results obtained at the Bureau of Standards last summer in some experiments with the point-by-point process, to illustrate that it is possible to attain very great accuracy in the determination of wave forms of alternating currents. In order to ascertain the shape of the e.m.f. wave of a certain machine, there were placed in parallel three circuits—an inductive, a non-inductive and a condensive. The current in each circuit was analyzed to determine the harmonics so as to calculate the value of the e.m.f. wave. In comparison with the fundamental, the third harmonic was a little less than 2 per cent, the fifth harmonic a little more than one-tenth of 1 per cent, the seventh harmonic was almost negligible, while the ninth, eleventh and thirteenth had values less than one in 1,000. In comparing the results as calculated from the three currents, it was found that if the waves were drawn out in curves 3 in. high the variations would amount to about one one-hundredth of an inch. In regard to the accuracy of switchboard instruments, it is hardly necessary to say that they should not be used as precision instruments for testing. In a series of tests recently made at the Bureau of Standards it was found that the design of certain ammeter shunts was such that the variations in the contacts of the terminals of the bus-bars or leads would change the distribution of current at the terminals of the shunts, and change the difference of potential between the ends. In one particular case the variation from the maximum and minimum values, found by connecting up and disconnecting, amounted to 8 per cent. It is sug-

gested that there should be provided means for inserting a standard resistance in order to calibrate switchboard instruments. The standard resistance should have a very small thermo-electric coefficient, and should be provided with a large radiating surface, or submerged in oil, so as to be kept cool.

Dr. Clayton H. Sharp remarked that all oscillographs are difficult to use and are sure to get out of order by the breakage of the vibrating strips or by the detachment therefrom of the mirror. The construction of two well-known foreign makers of oscillographs is such that no man of ordinary skill could replace a broken strip without the expenditure of a great deal of time and patience. The oscillograph which Mr. Robinson has designed, on the contrary, can be repaired with the greatest facility. The manipulation of this oscillograph is in other respects moderately simple, and the results are all that are required for any ordinary testing. Records have been obtained of condenser currents with frequency as high as 3,500 cycles per second, and it would seem that this frequency is as high as is required in commercial work.

Mr. A. R. Everest, in discussing the use of transformers with recording instruments, stated that the current transformers designed by at least one large manufacturing company possessed a high degree of accuracy, the error being less than 1 per cent over the entire useful range of the instrument. The statement by Prof. Nies that a pressure transformer differs in no radical way from an ordinary transformer is misleading. The pressure transformer for instruments is as much a special type of transformer as the meter is a special type of alternating-current motor. Such a transformer is always excessively large for its output, compared with a lighting transformer. With any secondary load within its rating it should have an error of less than 1 per cent.

Mr. F. C. Pratt remarked that it was almost impossible for the stray fields from one transformer to influence the operation of another transformer, as intimated by Prof. Nies. In regard to the suggestion of Prof. Nies that three single-phase meters should be used for three-phase work, he thought it questionable if the same amount of effort which would have to be expended upon these three meters could not be more judiciously employed in other directions.

Mr. A. H. Ackermann discussed the effect of improving the bearings of meters. In a certain lot of three-phase meters equipped with sapphire jewels, the registration was never within 10 per cent of the correct value. After these same meters were equipped with cupped diamonds the errors in registration did not exceed 1.5 per cent. Referring to the report of the Gas and Electric Light Commissioners in Massachusetts, it is to be noted that 48 per cent of the gas meters were found fast, while only 14 per cent of the electric meters were fast. He thought the comparison was one of which the electric meter need not be ashamed.

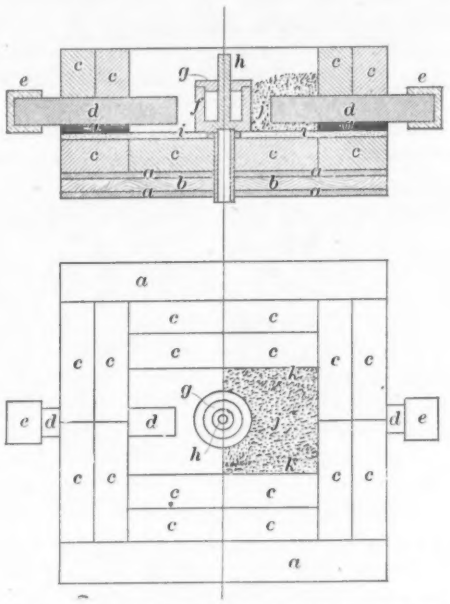
The Electric Furnace in the Production of Diamonds.

Mr. Henry W. Fisher, chief engineer of the Standard Underground Cable Company, read an interesting paper before the Pittsburg Academy of Sciences and Arts, April 6, entitled "Production of Diamonds by Artificial Means." After describing in considerable detail the work of Henri Moissan in the production of diamonds by the intense heat of the electric furnace, Mr. Fisher gave an account of experiments of his own along this line.

In Figs. 1 and 2 are shown a section and plan of the furnaces used by Mr. Fisher. *a a* is asbestos above and below the table, *b; c c* are fire bricks; *d d* graphite electrodes; *e e* castings of brass over the ends of the electrodes; *i i* a lining of magnesite; *f* is the crucible, part of which extends through the table; *g* is the cover of the crucible, and *h* is a valve stem which can be lifted to allow the contents of the crucible to fall into the cooling chamber below; *f, g* and *h* are made of pure graphite, and *j* is cracked coke placed in the crucible around the electrodes, the portion at the end of the electrode being finely divided so as to insure fairly uniform distribution of heat. Fig. 2 is a plan view looking down from the top of the furnace, the same letters being used as above to designate the different materials. At each side of the graphite, *j*, is a lining of magnesite, *k*, which is broken quite finely. This material makes an excellent insulator of heat and being in a powdered form does not conduct much current when the furnace is very hot.

Fig. 3 shows a casting or matrix which fell into the graphite mould surrounded with water, this mould being really an extension of the crucible. The graphite was very thin, so that the matrix would be cooled rapidly. The intense heat of the matrix seems to have generated gas which flowed to the center, the point of least resistance. The specimen is beautiful in appearance, containing passages which are as bright as though they had been nickel-plated and polished.

Fig. 4 is a reproduction of a microphotograph of the first diamonds produced, which were transparent and brilliant, the photograph being taken by direct light on top. A lot of which Fig. 5 shows one speci-



FIGS. 1 AND 2.—SECTION AND PLAN OF FURNACE.

men, contains several perfectly transparent crystals, which apparently were fragments of a larger crystal. The largest measured ½ mm., and when burned on platinum foil there was left only a trace of ash. The long, sharp crystal was very brilliant and evidently was fractured, as the edges were sharp. This picture was also taken by direct light from the top; in attempting to take it by transmitted light from the bottom, the plate was fogged from the brilliant reflected light around the crystal. Figs. 6 and 7 are reproductions of microphotographs of another lot of diamonds. Fig. 6 was taken by direct light from the top, and Fig. 7 by transmitted light from the bottom. The tendency of the diamond to fog the plate is evident in Fig. 7.

The crucibles were made of Acheson graphite. The first furnaces made by Mr. Fisher were of lime, like those of Moissan, but did not

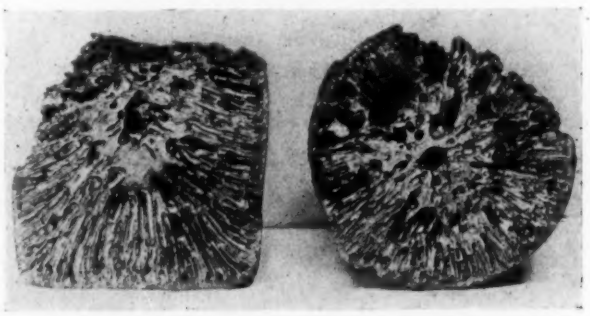


FIG. 3.—EFFECT OF HEAT ON MATRIX.

work satisfactorily, and the same was true of furnaces made of asbestos board and lined heavily with magnesia blocks. Finally, the furnace above described was constructed, by means of which an intense heat could be generated all around the crucible.

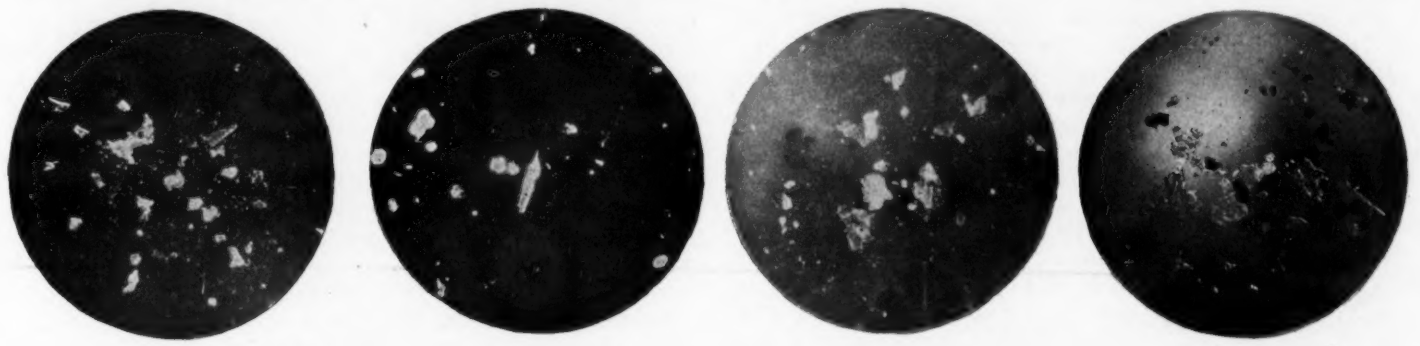
It was evident that there was a considerable reduction in the temperature of the matrix during the time required to take hold of the crucible with the tongues to empty it. Consequently, several methods were devised whereby the matrix could be instantly dropped through the bottom of the furnace into its cooling chamber. The first plan was to use a crucible consisting of a hollow cylinder of graphite placed on a flat slab of graphite which extended outside the furnace; by pulling this out the contents of the crucible were let fall into the

cooling chamber. The cooling was first effected in a bath of solder or in a large lead casting with a hole in the center.

The next plan was to place the crucible in a tube of graphite which was surrounded with coke containing the electrodes. The bottom of the tube was closed by a pivoted drop door of asbestos covered with graphite and a graphite cover was placed over the top of the tube. Under these conditions both the tube and crucible became intensely hot. A large iron can about 2 ft. high filled with water was put under the furnace; after the matrix and crucible became intensely hot, the trap door was allowed to drop and instantly the contents of the crucible, containing perhaps two pounds of material, dropped into the water. At the first trial the crucible fell on its side, releasing the matrix, which was so hot that it instantly melted a large hole in the bottom of the iron vessel; the water was violently agitated and a bluish-white flame, probably due to the decompositon of water, was visible for a few seconds. Subsequently the arrangement was such that the crucible was allowed to fall into the water in such a manner as not to be upset. These and other experiments showed that the material must be cooled very rapidly. Small lumps that in the water became detached from the mass in the crucible contained diamonds, which was not the case with the large lump remaining in the crucible and partly insulated by it. In one case, when the matrix contained an excess of graphite, this became pasty when extremely hot and on cooling was partly malleable.

The maximum power employed was about 50 kw. As to the temperature attained, a pyrometer reached its maximum of 1,950° C. long before the greatest heat was arrived at, and it was estimated that the temperature of the matrix was between 2,500° and 2,800° C., although in some places the temperatures probably reached 3,500° to 4,000° C. The current flowing was as high as 1,200 amperes.

In conclusion, Mr. Fisher said that in future investigations he would experiment with a method not involving heat processes, by which diamonds of large size might possibly be made.



FIGS. 4, 5, 6 AND 7.—ARTIFICIAL DIAMONDS PRODUCED IN ELECTRIC FURNACE.

Variable Speed Shunt Motors.

In a discussion of a British I. E. E. paper, Mr. H. M. Hobart said that the design of a motor for variable speed by shunt control is, in reality, the simplest case with which a designer had to deal, the reason being that, if the speed range is to be at all great, it was useless to set the brushes with a fixed angular displacement from the neutral position for the purpose of assisting the commutation. The extreme case is met in the motor which had to run in either direction. The motor is then designed with the brushes in the geometrically neutral position and with a sufficiently low reactance voltage to preclude sparking at the highest speed required for a given load. It is well to choose as low a maximum speed as possible. If it is required to drive a machine tool with a maximum speed of 100 revs. per min. and a minimum speed of 25 revs. per min. it would be well to choose a very low gear ratio. For instance, if 10 hp is required, the corresponding speeds should be 400 and 100 revs. per min. rather than, say 1,000 and 250 revs. per min. This would be the more important the higher the voltage. Thus, for a 440-volt system it would be highly important to adopt the lower speeds, whereas for a 110-volt system the higher speeds would give a good result. For 220 volts the lower speeds would, on the whole, be preferable.

Boston Meeting of the American Electrochemical Society.

In our last issue we gave an account of the proceedings of the first session of the American Electrochemical Society meeting held in Boston from April 25 to 27. The success of the later sessions was even greater than that of the first one, the attendance being beyond 100 on the last day. Due to the cordiality of the local committee the social functions as well as visits and excursions were extremely enjoyable affairs.

At the business meeting, held on Wednesday morning, the reports of the secretary and treasurer were read and accepted; they show that the society is in a very good financial condition. The proposed amendment to the constitution by which the time of election of officers is slightly changed, was accepted. The result of the annual election of officers was announced in the Thursday meeting and is as follows: President, Dr. Wilder D. Bancroft; vice-presidents, Messrs. Carl Hering, Louis Kahlenberg, E. F. Roeber; managers, Messrs. C. A. Doremus, C. P. Townsend, W. R. Whitney; secretary, Mr. S. S. Sadtler; treasurer, Mr. G. P. Salom.

After the morning session of April 25 a reception was held by President Pritchett, of the Massachusetts Institute, at the Technology Club, followed by a lunch given by the Institute. After the Wednesday session, a reception was held by President Eliot, of Harvard University, at Harvard Union. On this occasion President Eliot made a speech on the tendencies manifesting themselves now in the United States with respect to higher scientific and technical education. A lunch was then taken which was tendered by Harvard University.

Excursions were made in the afternoon to the works of the General Electric Company at Lynn, and to the plant of the New England Gas & Coke Company, at Everett. Extended visits were also paid to the buildings and laboratories of the Massachusetts Institute of Technology and of Harvard University.

On Tuesday evening a smoker was held in the Palm Garden of the Hotel Lenox and on Wednesday evening a banquet in the same hotel, where Dr. A. E. Kennelly acted as toastmaster, speeches being made by Dr. Carhart, Dr. Richards, Dr. Wiley and Dr. Franklin.

TUESDAY'S SESSION.

On page 788 of our last issue were given abstracts of most of the papers presented at the Tuesday meeting. In addition to these the following is to be mentioned:

EDISON STORAGE BATTERY.

A paper on this subject was presented by Mr. M. DeK. Thompson, who gave the results of an experimental investigation which has been made in the electrochemical laboratory of the Massachusetts Institute and which related especially to the determination of the single potentials of the two electrodes during charging and discharging with different concentrations of the electrolyte. The results were illustrated by lantern slides. It was shown, for instance, that in a five per cent solution the discharge curve of the iron electrode is essentially different from the curve in a twenty per cent solution.

EVENING SESSION AND PRESIDENTIAL ADDRESS.

In the evening session Dr. W. H. Walker gave an explanation of the various chemical apparatus and electric furnaces which were exhibited by Messrs. Eimer & Amend, of New York.

The retiring president, Dr. Henry S. Carhart, then presented his

presidential address, which dealt with a concise historical sketch of the development of the theory of electrolysis.

The speaker gave a great many very interesting notes on the views held a hundred years ago on the nature of electrolytic action. He spoke with some enthusiasm of Grotthus' theory and gave a summary of the later development of the theory due to the work of Clausius, Hittorf, Kohlrausch, Arrhenius and van't Hoff. J. J. Thomson's recent researches on electric conduction through gases are also throwing a new light on the phenomena of electrolysis, and we have not yet arrived at the ultimate truth.

WEDNESDAY'S SESSION.

CHROMIUM BY ELECTROLYSIS OF CHROMIC ACID.

The first paper of the Wednesday session, which was held at Harvard University, was presented by Dr. H. R. Carveth and B. E. Curry on the electrolytic production of chromium from chromic acid solutions. The authors showed the reliability of work done by Geuther fifty years ago. This work was later considered to be inaccurate by various investigators, but the present authors show that its main part is correct. Metallic chromium is deposited in the electrolysis of solutions of chromic acid if a high current density is applied, which in this case is synonymous with a high deposition voltage. Electrolytic chromium may occlude as much as 250 times its volume of hydrogen. This may account for its hardness and the authors seem to consider it possible that chromium coatings will become commercially useful for certain purposes. The paper was discussed by Drs. W. R. Whitney and J. W. Richards.

ELECTROLYTIC PRECIPITATION OF SILVER.

Mr. Ralph C. Snowdon presented a paper on this subject which, in the absence of the author, was read by Dr. Carveth. The main results are as follows: A very finely crystalline deposit of silver can be obtained from a silver nitrate solution by rotating the cathode rapidly and keeping the anode and cathode solutions separated. The size of the crystals decreases with the increase in current density and the increase in the rate of stirring at the cathode.

The addition of small amounts of organic "colloids" to the solution makes the deposit very amorphous and causes the precipitated metal to assume a colloidal state. The presence of free nitrate acid decreases the size of crystals but slightly.

The electrolytic precipitation of silver is thus in harmony with the general theory of the chemistry of electroplating, proposed by Prof. W. D. Bancroft.

The paper was discussed by Messrs. Carhart, Sadtler, T. W. Richards and Kern, especially with relation to the silver coulometer. The use of the term coulometer instead of voltameter, was very strongly advocated, to avoid misunderstandings; what this instrument measures are coulombs.

ELECTRODEPOSITION OF METALS ON ALUMINUM.

Mr. Alexander Lodyguine described some experiments on the electrodeposition of metals on aluminum. In order to construct a light lead storage battery the author tried to use thin aluminum plates and to coat them electrolytically with antimony or antimonious lead. He found that he could not do so directly and therefore covered the aluminum surface first with a coat of copper on which he plated antimony. To deposit the copper he used an anode of pure copper and an electrolyte of pure water with a few drops of sulphuric acid in it; the pressure was about 0.5 volt. To deposit the antimony he used a concentrated solution of protosulphide of sodium. Lumps of trisulphide of antimony were placed in a porous cell of very oblong form, around a carbon plate. The cell was filled with the electrolyte and placed in a glass jar filled with the same electrolyte. Two plates of aluminum coated with copper were used as cathodes; the voltage was 1 to 1.5, while the current density for the deposition of the copper on the aluminum and of the antimony on the copper was 0.0013 amp. per square inch.

REDUCTION OF TITANIFEROUS ORES.

A second paper by Mr. Alexander Lodyguine gave some results of experiments which he obtained in a small experimental electric furnace for the reduction of titaniferous ores. On account of the inexhaustible deposits of such ores in the United States he thinks that they will play a very important part in the future of the iron and steel industry of this country. For their treatment, however, the blast furnace is not suitable, and an electric furnace is to be used. It is possible in the electric furnace to obtain in the final product as large or small a percentage of titanium as desired. The real advantage of the treatment of titaniferous ores lies in the high value of the by-products, especially ferro-titanium, titanium carbide, etc. The paper was discussed by Dr. Richards and A. J. Rossi; the latter, who has made extensive experiments with titanium, stated that there is no difficulty in handling titaniferous iron ores.

DIELECTRIC CONSTANT.

A paper by Dr. Louis Kahlenberg gives the results of a determination of the dielectric constants of free oleic acid and of a number of its typical salts. The dielectric constant of oleic acid at 20° C. is 2.50 to 2.60. The dielectric constants of metallic oleates were found to have about the same value, although they are mostly somewhat greater. This seems to indicate that the characteristic electric properties of the metals are almost entirely overcome by the union with the large fatty radical of the oleic acid.

ROTATING DIAPHRAGM.

A paper by Prof. Wilder D. Bancroft on this subject, in the absence of the author, was read by Dr. Carveth. If in an acidulated copper sulphate solution a cylindrical graphite rod is interposed between two copper electrodes, copper will be deposited on one side and oxygen developed on the other side of the graphite rod, if the impressed voltage is high enough. After this has been done, the graphite cylinder may be revolved through 180°, so that the precipitated copper side will now face the cathode. The copper will then dissolve and the graphite cylinder will behave like a reversible intermediate electrode. Instead of reversing the graphite diaphragm repeatedly through 180°, it is possible to revolve it rapidly. In this case it will also behave like an ideally reversible electrode. Experiments show that no visible amount of copper precipitates on such a rotating electrode, although a considerable proportion of the total current flows through the electrode.

SOLUTION HEAT.

A paper by Dr. H. E. Patten dealt with the heat of solution of aluminum bromide in ethyl bromide. The heat of solution was compared with the decomposition voltage and it appears that in this case Thomson's rule is approximately correct.

ATOMIC WEIGHTS AND ELECTROCHEMICAL EQUIVALENTS.

A paper of a highly theoretical nature was presented by Prof. Avid Reuterdahl on the interdependence of the atomic weights and the electrochemical equivalents. The relation existing between the same was made use of in the study of certain problems of the corpuscular theory of matter, especially for calculating the electric charge of free ions.

ELECTRIC REDUCTION OF LEAD OXIDES.

A paper by Mr. A. Lodyguine describes experiments which were undertaken for the purpose of electrically extracting lead from the lead peroxide of old storage batteries, instead of selling the peroxide to junk dealers. An electrolytic process for this purpose is described in detail, the change from peroxide to spongy lead taking place not directly, but through various intermediate stages of oxidation. The extraction of one short ton of pure lead from peroxide by his process requires about 435 kw-hours.

UTILIZATION OF BLAST FURNACE GASES.

Mr. A. J. Rossi presented a paper on the utilization of blast furnace gases in connection with the electric smelting of iron. If the blast furnace gases are not utilized as at present under boilers, etc., but after the needs of the furnace plant itself have been met, the surplus of gases available is consumed in gas engines driving electric generators, an enormous amount of electric power will be available. With the production of 20,000,000 tons of pig iron—which is the figure per year for the United States—there will be available not less than 1,000,000 or 1,200,000 hp by the most conservative estimate, and this figure may become as high as 2,000,000 hp.

The author shows in detail that even if the amount of fuel consumed should be considerably reduced, as was the case in Gayley's dry blast run, yet the power available would not be decreased to the same degree. As the minimum figure he finds 468 hp-hours per ton.

The paper was followed by a lively discussion in which Messrs. H. H. Dow and E. A. Sperry spoke strongly in favor of the steam plant and claimed that the gas plant is too complicated and requires too high a capital and has too high a labor charge. On the other hand, the gas engine proposition was defended by Mr. E. R. Taylor and with great strength by Dr. J. W. Richards.

THURSDAY SESSION.

The Thursday session was held again at Lowell Hall of the Massachusetts Institute of Technology and was made specially interesting by a number of experimental and illustrated papers. One of them on the mercury vapor lamp by Dr. Weintraub of the Research

Laboratory of the General Electric Company is covered in detail in our next isue.

ELECTROLYTIC METHOD FOR SEPARATING AND CONCENTRATING ORES.

A paper by Prof. L. I. Blake gave a description of the Blake-Morscher electrostatic separator. In the absence of the author the paper was read by Mr. C. E. Locke. If there is a mechanical mixture of two kinds of crushed materials with different electric conductivities, and if this mixture is brought into contact with an electrostatically charged surface, the two different materials will get a different charge in the same time. If, for instance, one material is a conductor, and the other a non-conductor, the latter will remain uncharged, while the former gets a charge. As soon as this takes place the charged particles only are repelled from the charged surface so that in this way a separation of the conducting and non-conducting materials is accomplished. This is the fundamental idea on which the electrostatic separator is based. In a general way most sulphide minerals and most copper, iron, etc., minerals are conductors, while the gangue, waste minerals quartz, etc., are non-conductors. Zinc blende is an important exception to this rule, since it is a non-conductor. To carry out the process in practice it is necessary first to crush the ore; second, to dry it thoroughly; third, to feed it in a suitable manner to the charged surface, and, fourth, to collect and remove the separated materials. The voltage required is 350,000, and is furnished by a special electrostatic machine, acting not by friction but by induction. The leakage in the electrostatic separator is considerable. Nevertheless the total power required for a separator treating 12 tons in 24 hours is not more than one horse-power. Most of the electrostatic separators now in practical use are applied for separating pyrite or marcasite from zinc blende. This is done without roasting.

COLLOIDS.

A very interesting lecture with a great many experiments on the subject of colloids was delivered by Dr. W. R. Whitney, who gave a full summary of our present knowledge of colloids. He explained that colloids fundamentally differ from solutions, since they exert no osmodic pressure. He showed that colloids may be divided into positive and negative colloids, migrating under the influence of the electric current in different directions and precipitating other colloids of the other class, but not of the same class. He described with the aid of experiments various methods for producing colloidal solutions (or as he preferred to say, suspensions) and discussed biological applications as well as applications to the dying of textile fabrics.

AN ELECTROLYTIC SWITCH.

A paper on this subject was presented by Mr. William Smith Horry, who pointed out that the various properties of the aluminum cell are besides its assymetric peculiarity, that it presents a high resistance to the passage of an electric current, it possesses capacity and it leaks. These qualities may be turned to account for the purpose of preventing those arcs that occur when a current, possessing inductance, is interrupted.

As all continuous current circuits possess more or less inductance, the voltage rises across the break when a switch carrying such

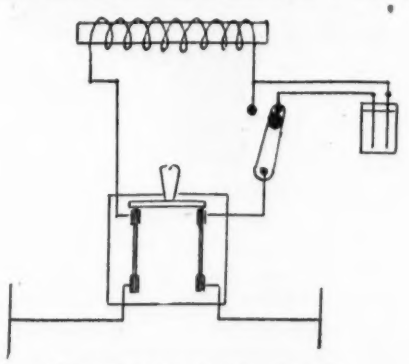


FIG. 1.—DIAGRAM OF CIRCUITS.

a current is opened. This not only causes an inconvenient flash at the switch, but endangers the insulation of the circuit. Field coils of electric motors are sometimes destroyed from this cause.

But if a suitable electrolytic cell be inserted across the break and the circuit then broken, there is no flash at the switch, and the increased voltage will force a current through the cell instead. The insulation of the cell then breaks down, but quickly re-establishes itself. After that the mains may be entirely disconnected without any spark.

To obtain the best results in this way an electrolyte for the cell should be chosen that substantially shuts off all current at the working voltage, but allows considerable leakage to occur with any increased pressure—a cell that has a critical voltage a little above the line voltage. For small cells intended for use on circuits of one horse-power or less at 110 volts the matter is not of much importance, but for larger ones it becomes so, as the electrolyte largely determines the size of the cell required for any given circuit.

The most simple diagram of the circuits is that shown in Fig. 1. The circuit is represented as a line containing an electromagnet, there is a double-pole switch for the line, a rheostat contact and an aluminum cell. If the switch is closed no current will flow except that which leaks through the cell, but if the rheostat arm is moved to the left, then the full current will pass. To shut off the current the rheostat is returned to the position shown, then the switch is opened.

But the cell possesses capacity, and, if it be a large one intended to suppress a powerful arc, there will be a spark at the arm contacts when the terminals of the cell are connected. To close the circuit sparklessly the rheostat must be moved before the the switch is closed If the arm be moved first, both in opening and closing the circuit, there will be no spark at make, due to capacity, and no arcing at break, due to self-induction. The author exhibited a switch which operates in this way with one movement of the switch handle. There are three knives to it, the middle one having a more extended movement than the other two, so that it operates always in advance of the outer blades. Fig. 2 gives a diagram of the connecting circuits.

The author described various cells of different sizes, which he has

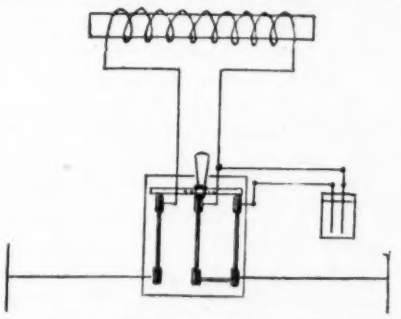


FIG. 2.—DIAGRAM OF CIRCUITS.

devised for various purposes. For long continued and rapid use a larger cell is necessary than for infrequent use, so that the heat generated by the continued arcing through the cell shall be radiated more rapidly.

SILICON.

Mr. F. J. Tone, of the Carborundum Company, presented a paper on the production of silicon in the electric furnace. It is very important to regulate closely the temperature in the furnace, since the temperatures of reduction and volatilization of silicon are very near together. For this purpose the electric silicon furnace of the author is specially designed. Silicon is used largely in the iron and steel industries in the form of ferrosilicon and silicon-copper.

In the discussion of the paper, Prof. Elihu Thomson spoke of the importance of this work, and said that he had found silicon to be an excellent resistance material in granular form. Mr. Henry S. Potter stated that Mr. A. B. Albro had succeeded in developing a process for utilizing silicon in a manner quite analogous to the use of aluminum in the aluminothermic reaction.

MICRO STRUCTURE OF SILICON AND ALLOYS.

Mr. A. B. Albro presented a paper on this subject, which was illustrated by a very long series of most interesting lantern slides, showing the microstructure of silicon and of alloys containing silicon. The author discussed successfully silicon, ferro-silicon and the action of silicon towards carbon and silico-carbides. Incidentally, he mentioned that Mr. H. S. Potter has developed a new process for making silicon.

ELECTRIC ARCS.

The last paper of the meeting was presented by Dr. W. R. Whitney, who made experimental demonstrations of different arcs obtained with different electrodes. There were exhibited ordinary carbon arcs and arcs between impregnated carbons as well as arcs be-

tween metals, and it was shown that the nature of the arc between two different metals is essentially changed if the direction of the current is reversed.

The following three papers were read by title. They are abstracted from the printed advance sheets.

STUDYING DIFFUSION IN ELECTROLYTIC CELLS.

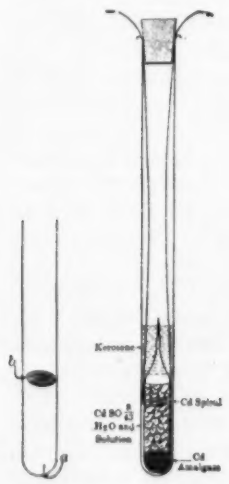
A paper by Mr. Carl Hambuechen refers to a misconception generally held with respect to concentration differences in electrolytic cells. He states that whatever differences of density there may be at the immediate surface of the electrodes, there is almost no variation in density on a horizontal line extending across the cell. Concentration differences in active electrolytic cells produce a continual movement of the electrolyte in such a way that if, for instance, the solution becomes more concentrated at the anode and more dilute at the cathode, the heavy anode solution sinks to the bottom of the cell and the lighter cathode solution flows in a steady stream to the top. The solution becomes stratified by layers of different concentration, the lighter layers being at the top of the cell and the heavier ones at the bottom. The author makes these differences of concentration visible by constructing a cell of such a size that it can be placed as a slide in a stereopticon lantern. Even though the eye may not be able to detect a border line between layers of different concentration, this line is produced on the screen through differences of the refraction of the light as it passes through the solution of non-uniform density.

ELECTROLYTIC PRECIPITATION OF NICKEL ON NICKEL.

A paper by Mr. Ralph C. Snowden refers to a well-known difficulty in the plating with nickel a metal on which there is already a coating of nickel. To get an adherent deposit it is generally necessary to remove the previous deposit. The author studied the reason for this difficulty, and his results are as follows: Nickel can be precipitated upon the "active" nickel cathode and caused to adhere without difficulty. Nickel cannot be successfully plated on other nickel because of the presence of a thin film of oxide, which cannot be removed except by rigorous reduction. The "active" state is very unstable.

THE LOW VOLTAGE STANDARD CELL.

Dr. George A. Hulett, in a paper on this subject, refers to the fact that the e.m.f. of cadmium amalgams, containing between 5 and 14 per cent. of cadmium, is constant at ordinary temperature, measured against any constant electrode. The author has, therefore, devised the following low-voltage cell: Cadmium, cadmium sulphate, cadmium amalgam. He has found that its e.m.f. remains very constant, while the e.m.f. of cells set up at different times and with materials from different sources agree remarkably well.



FIGS. 3 AND 4.—LOW-VOLTAGE STANDARD CELL.

The glass part (Fig. 3) is a thin walled tube some 8 or 16 mm. in diameter, closed at one end and provided with a platinum wire (*a*); two or three centimeters above the closed end is a platinum spiral (*b*), with its end fused through the side of the tube (the wires are thoroughly cleaned with aqua regia before filling the cell). The complete cell is shown in Fig. 4, in which new cadmium has been plated electrolytically on the platinum spiral. The e.m.f. of this cell is 0.05175 international volts at 20 degs. C. The temperature coefficient is negative and amounts to —0.000244 volt per degree, and is practically constant. The temperature coefficient is higher than could be wished, but the cell, in the form described, takes up its true value in a remarkably short time, when brought from one bath to another. Experiments indicate that the time taken is generally less than 15 minutes.

The small e.m.f. is an objection for a primary standard, but there is a very considerable amount of work done in which small electromotive forces are to be accurately measured—for example, temperature measurements with a thermo-couple. The fact that the e.m.f. and temperature coefficient of this cell are independent not only of the concentration of the electrolyte but even of the presence or absence of the solid salt makes it particularly interesting.

Westinghouse Train Control System.

For the operation of a number of motor cars assembled as a single train it is essential that there be provided some arrangement by which all motors may be controlled from a single point. One of the latest developments in apparatus for accomplishing this object is found in the Westinghouse electro-pneumatic system of train control as described and illustrated herewith.

The actual work of operating the controller mechanism for each car is performed by compressed air, which is obtained at a pressure of 70 lbs. per sq. in. from the braking system. To each switch is mechanically connected a powerful spring which tends to keep it open. The air pressure exerted upon the suitable cylinders serves to force the switches closed. When the pressure is removed the circuit is quickly broken at the switches, there being provided a magnetic blowout for assisting in rupturing the arc.

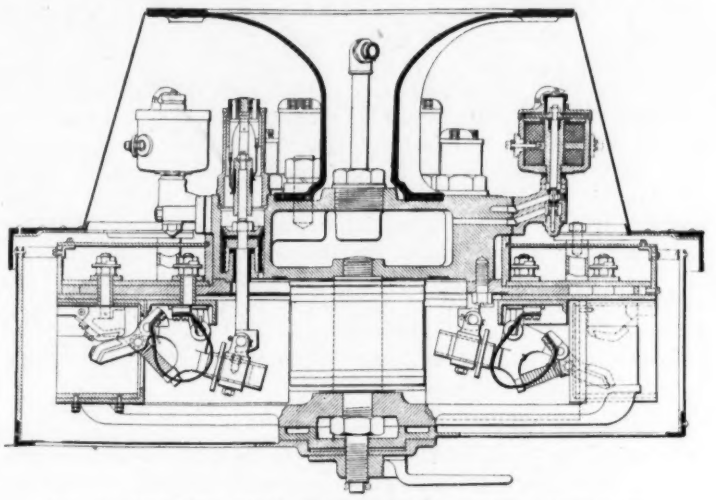


FIG. 1.—IMPROVED FORM OF UNIT-SWITCH-GROUP CONTROLLER.

There are thirteen main motor-circuit switches, each with its air cylinder. The valves for the air cylinders are opened as desired by means of electromagnets which are supplied with current from a 7-cell storage battery hung under the car. Two of these batteries are provided so that one may be charged while the other is in use. The charging current is obtained from the main trolley circuit, either a series of lamps or a compressor motor being used for limiting the current taken by the battery.

FIG. 2.—INTERIOR VIEW OF MASTER CONTROLLER.

A small master controller serves for governing the operation of the electromagnets. When the controller handle is in the central position, all circuits are broken, while movement of the handle in one or the other direction causes the car to travel forwards or backwards, there being three notches in each direction. On the first notch, the reverser is placed in the proper position, the circuit-breaker is closed and the motors of each car are placed in series with all of the resistance in circuit. On the second notch, the resistance is gradually cut out, until the motors are finally running without resistance in circuit. On the third notch the motors are

placed in multiple, and in series with resistance which is gradually cut out as the motors gain speed.

Although the placing of the handle of the master controller on either the second or third notch insures that the motor will finally be connected either in full series or in full multiple without resistance, the actual cutting out of the resistance is governed by the current taken by the motors. Each electro-pneumatic valve is provided with both an operating coil and a holding coil. The object of the latter coil is to hold the switch in position after it has been closed by the operating coil. A limit switch serves for preventing any operating coil from closing a switch when the current taken by the motors is above a predetermined value. When, however, the current falls below this value, the switches are closed in the proper order by means of the operating coils.

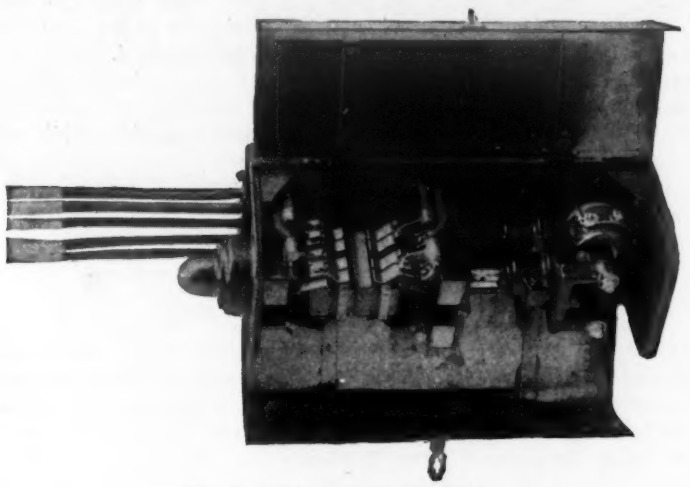


FIG. 3.—NEW TYPE OF REVERSER.

In the recent designs of the unit switch group, as shown in Fig. 1, the construction of the switch-operating pneumatic cylinders has been so changed as to include the "interlock" contacts within their spaces. This does away with the extension chambers formerly used for this purpose. The contact arms are hinged in a new way, with a long, easy spring, which is compressed in closing the switch. The action of the hinged arm under the tension of the spring is to cause the wiping-contact effect which is so desirable in keeping the contacts clean. An important alteration has also been made in the arc deflectors, by the use of a heavy soapstone cell for cooling the arc and contact arm, and also a heavy new electrobestos shield is used in lining the unit switch pockets.

The master switch, an interior view of which is given in Fig. 2, is of a new pattern, with a horizontal shaft. In this form it is much easier to care for, as all parts are readily accessible. In the latest form of the limit switch, the contacts are of solid platinum, so as to make the device most reliable in service. The reverser, which is shown in Fig. 3, is entirely enclosed in a protecting case, and the air valves are now completely enclosed.

The actual details of arrangement of all the connections for both the low-voltage control circuits and high-voltage motor circuits, and also the line switch, reverser, line relay, limit switch, etc., for the control system are shown in the diagram of connections of Fig. 4. Experience has shown the system to be well adapted to service requirements, the simplicity introduced in the new design being an important advantage in its operation and maintenance.

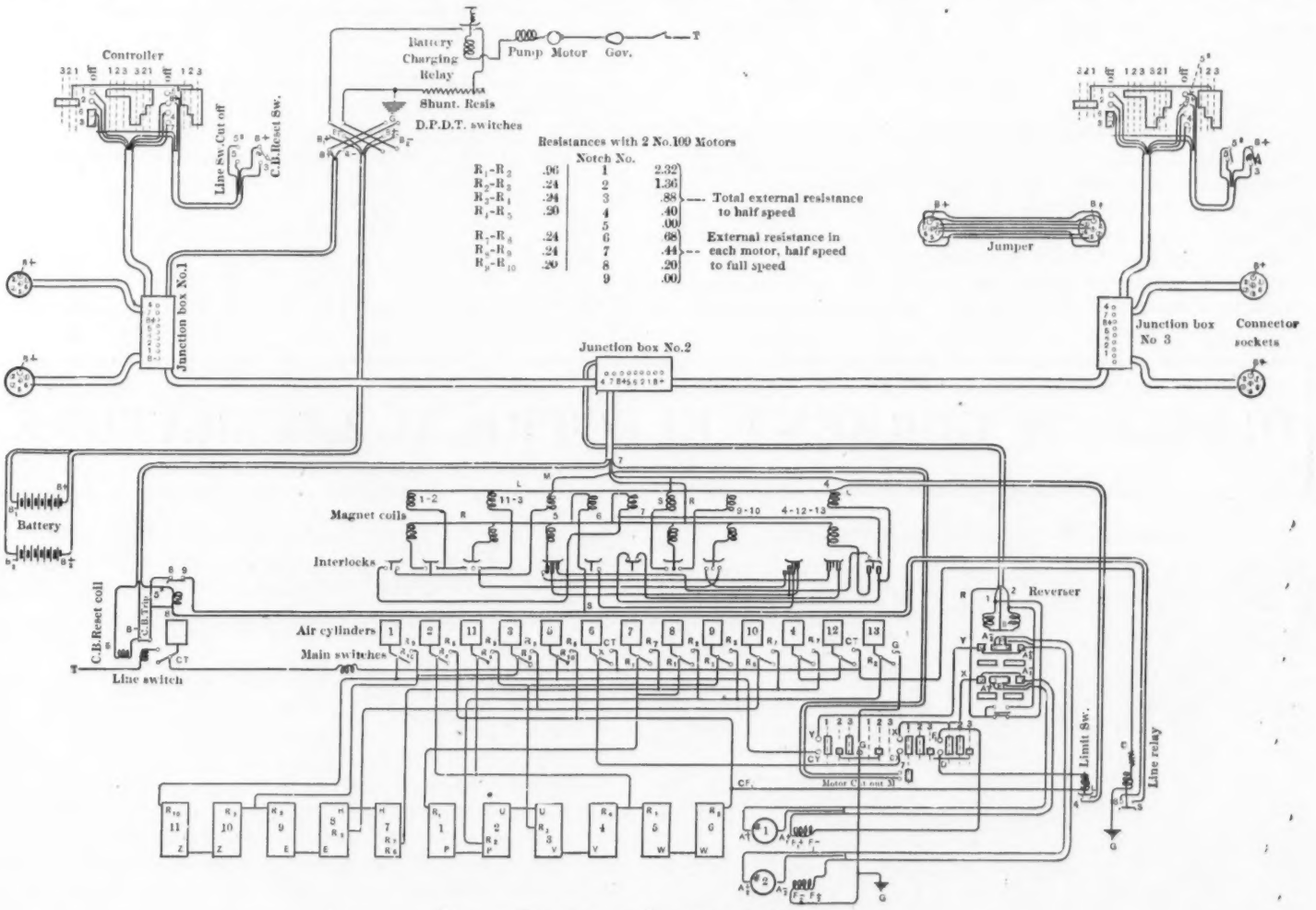


FIG. 4.—DIAGRAM OF CONTROLLING CIRCUITS.

New Telephone Patents.

THROUGH TRUNK SIGNALS.

Considering that the use of through supervision on tunnels is a matter of every-day practice, it seems rather odd that a patent for such a system should be just appearing. Nevertheless such is the case, the application for the patent having been made in 1897. The patent provides a system of circuits such that in case a subscriber at one central office is connected through to a subscriber of a distant central office, the connection being under the supervision of the answering operator at the calling end, the operation of the hook switch of the distant subscriber will affect the supervisory

signals of the operator at the calling end. Not only this, but additional supervisory lamps are placed in front of the trunk operator and these lamps indicate the position of the switch hook of the called subscriber's office. This signal system is the invention of Messrs. C. E. Scribner and F. R. McBerty, and the patent is assigned to the Western Electric Company.

BUSY TEST CIRCUIT.

A second patent assigned to the Western Electric Company is one relating to a busy test system for common-battery exchanges, and is the invention of J. G. Roberts, of Chicago. The scheme involves as its most novel feature the connection of the busy test to the test rings of all jacks of a line as soon as a subscriber removes his receiver from the hook in an attempt to call in. This provision is, of course, in addition to the usual busy test corresponding to the insertion of a plug in a jack of the series. The system as described is applied to a two-wire multiple system.

COMBINED POWER AND TELEPHONIC TRANSMISSION.

C. R. Van Trump, of Wilmington, Del., has patented an arrangement whereby he proposes to use the same wire simultaneously for telephone and power transmission. He shows a single or grounded return trolley system so equipped. The arrangement consists, as in the Van Rysslehersh system, of simply connecting a telephone instrument to the lines in series with a condenser, and in putting an impedance between the generator and motor circuits. Of course, in practice, the telephone current will be overpowered by the superimposed currents of commutation, and the current fluctuations at the trolley contact.

MISCELLANEOUS.

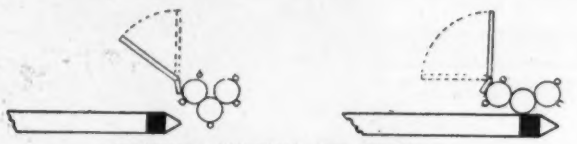
A polarized relay for party line working is described under the rather remarkable title of "Telephone Exchange System," in a patent granted to J. C. Hubinger, of Keokuk, Iowa. The relay is for use in selective systems, and the armature assumes normally a neutral position from which it may be deflected either way at will by properly poled current.

Edwin D. McLean, of Marissa, Ill., has been granted a patent for an adjustable receiver support. This is adapted to be connected to the receiver hook, so that this is properly manipulated when the support is moved from the operative to the non-operative position.

A rather novel insulator and support has been invented jointly by Messrs. R. J. McDaniel and S. V. Graves, of McFall, Mo. While this device will undoubtedly answer the purpose for which it was designed, there are disclosed no features which would indicate that it is any marked improvement over the prior art.

SELF-RESTORING DROP.

Many designs of combined jack and drop have been produced in which the insertion of a plug in a jack in the act of answering causes the restoration of the drop shutter. These apparatus have been of every degree of complexity, but surely one of the most simple is that just patented by J. L. Gemmill, of Cleveland, Ohio. The action may be understood best by reference to the cut below which is diagrammatic, and shows the alignment of the plug with reference to the restoring means. In the normal condition, the middle ball



GEMMILL ANNUNCIATOR RESTORER.

falls from between the other two. The falling shutter throws the front ball to the rear. When the plug is inserted, the middle ball is forced up between the others to restore the shutter. Mr. Gemmill's patent has been assigned to the Gemmill Telephone & Manufacturing Company, of Orrville, Ohio.

LETTER TO THE EDITORS.

Wireless Telegraph Inventions.

To the Editors of Electrical World and Engineer:

SIRS:—Various notices have appeared in your columns relating to the invention of the electrolytic detector and of the syntonization of groups of waves. Allow me to add to the history of these two subjects by stating that the electrolytic detector was first described by my friend, Captain Ferrié, before the International Electrical Congress, Paris, 1900 (see *Proceedings* of the Congress, tome II, page 289); and that the method of acoustic syntony in contradistinction with the usual electrical syntony, was first described by myself in my English patent of May 3, 1900 (No. 21,909).

The apparatus described by Captain Ferrié was exactly the same as that described under Fig. 1 by Dr. Ives in your issue of December 20, 1904. This fact would seem to put an end to the controversy for priority still pending between Messrs. Fessenden, De Forest and Schlömilch—the inventor of the electrolytic coherer being Captain Ferrié, and none other. The new system of syntony claimed by Professor Pupin seems also to be the same as my own system.

PARIS, FRANCE. ANDRÉ BLONDEL.

DIGEST OF CURRENT ELECTRICAL LITERATURE

DYNAMOS, MOTORS AND TRANSFORMERS.

Harmonic Damper.—LEBLANC.—A paper read before the International Socy. of Electricians in Paris. A dangerous rise of voltage is often caused by resonance between the capacity of the network and the self-induction of apparatus connected to it. Resonance of the fundamental wave is never to be feared. The trouble is due to the third, fifth, etc., harmonics. The author has devised a means of annihilating the higher harmonics. He accomplishes this by means of circuits which offer a very small ohmic resistance to the passage of a current of given frequency and a very high resistance to the passage of any current of higher frequency. The theory of this method is given. The windings are placed on the pole pieces in a similar way as the amortisseur windings. To provide a machine with both kinds of windings the amortisseur windings may be placed on one-half of the poles and the windings for damping the harmonics on the other half.—*L'Eclairage Elec.*, April 1.

Rectifying Alternating Currents.—SONTIER.—An article discussing the disadvantages of electrolytic rectifiers and methods of overcoming them, especially the necessity of preventing the temperature from rising above a certain point. The author concludes that suitably constructed electrolytic valves can form a practical solution of rectifying alternating currents, if the effective current is not above 10 amperes. Beyond this value and up to 30 amperes, he thinks it is preferable to use the mercury vapor rectifier, while for still higher currents, rotary converters or motor-generators should be used.—*L'Industrie Elec.*, March 25.

Voltage Drop in Alternators.—DRUCBERT.—Continuation and conclusion of his illustrated article on the application of various methods for determining the drop in voltage at the terminals of alternators. He discusses the methods of Portier, Fischer-Hinnen, Loppe, himself, Heyland and Guilbert, and applies them to numerical cases.—*L'Eclairage Elec.*, March 25, April 1.

Induction Motors.—ANGERMANN.—A long paper discussing in detail the best arrangements of the different tests for separating the losses in an induction motor.—*Elek. Zeit.*, March 30.

The Synchronous Motor.—An illustrated didactic article describing the operation of the synchronous motor.—*Amer. Elec.*, April.

LIGHTS AND LIGHTING.

Fluxes of Light from an Electric Arc with Varying Power Supply.—DYKE.—An abstract of a (Brit.) Phys. Soc. paper in which the author gives the results of experiments made on the electric arc with the following objects: First, to obtain a series of curves for alternating and continuous arcs of different lengths showing the relation between the mean spherical candle-power and the power sup-

plied to the arc; second, to compare the efficiencies of the alternating and continuous arcs under different conditions of arc length and power supply. The subject being too wide to deal with in its entirety, the following restrictions were made: The carbons used were 12 mm. diameter cored (upper) and 10 mm. solid (lower). The frequency of the alternating current was 80 cycles. The mean spherical candlepower was determined directly by means of an integrating photometer devised by the author. Curves connecting the mean spherical candle-power with the watts were determined for eight arc lengths, varying from 1-16 in. to 7-16 in. for both continuous and alternating currents. These curves are straight lines, which cut the axis of watts at points between 200 and 400 watts. Alternating and continuous current curves for the same arc-length are found to meet the axis of watts in the same point, showing the equality of the losses by dissipation of energy in forms other than that of light. For normal arc-lengths the alternating-current efficiency is about two-thirds of the continuous-current efficiency. If the arc-length is reduced below ⅛ in., the alternating-current curve rises towards the continuous-current curve until, at an arc-length of about 3-32 in., the two efficiencies practically coincide. On further reducing the arc length, the alternating-current curve rises above the continuous-current curve. An approximate analysis of the case of equal efficiencies is given, the results of which indicate an arc-length similar to that obtained experimentally. In the discussion which followed, Fleming referred to the practical value of the experiments, stating that the ordinary method of comparing lamps by their mean hemispherical candle-power was unscientific, and what was wanted was the total flux of light per watt. He instanced the case of a Nernst lamp and an ordinary carbon filament, pointing out that the ordinary tests indicated that the Nernst lamp was twice as efficient as the ordinary lamp, whereas a comparison of the total flux per watt showed an increased efficiency in the Nernst lamp of only 25 per cent.—Lond. *Elec.*, March 31.

Electricity versus Gas.—ADAMS.—An article on electricity from water power versus illuminating gas. Some statistical data are first given to show the failure of illuminating gas to hold its own in competition with electricity developed by water power. This is due in part to the superiority of the electric service and in part to the higher cost of gas for equal results. In many places supplied with hydro-electric plants, the rates for energy used in lighting are about 10 cents per kw-hour, but even at this rate the cost of operating a standard 50-watt, 16-cp incandescent lamp is only ½ cent per hour, or the same as that for the gas flame of equal illuminating power. In the field of industrial heating for cooking, welding, the reduction of certain chemical compounds and the like, electrical energy from water power has a great advantage in cost over gas, because of the rapidity of the electric action and its power of concentration at a particular point.—*Cassier's Mag.*, April.

POWER.

Electrically Driven Lifts.—HUNT.—A paper read before the New Castle Section of the (Brit.) Inst. Elec. Eng. In discussing the most suitable type of motor for lifts he excludes at once the series motor as "hopelessly bad," so that the choice lies between shunt and compound-wound machines. He then points out that the greatest trouble with lifts supplied from public lighting mains is their tendency to cause fluctuation of voltage by their demand on the mains at the instant of starting, so that it is difficult to see how the shunt motor can be really as satisfactory as a properly designed compound-wound motor arranged to have its compound coils cut out after the process of accelerating is accomplished. The compounding merely takes the place of the last section of the starting resistance, so the complication of the controller is more imaginary than real. Where cheapness is an essential, hand-rope gear is at present the commonest method of operating the reversing and circuit-breaking switches. When speeds of more than 160 ft. per minute are required, it is now becoming usual to supersede the mechanical hand-rope transmission by an electrical method, in which the attendant merely move a switch in the cage. "Formerly the American method of causing the motor to provide mechanically the motion necessary to cut out its own starting resistance was very much in favor, and it is still retained by some makers, owing to its inherent properties of preventing the motor from being started against an overload, and also the certainty of a definite time being taken to cut out the starting resistance. It has, however, the serious drawback that, unless other auxiliary apparatus is employed, it is necessary that sufficient current to start the motor shall pass through it on the first contact stud. General practice now appears to tend in the direction of obtaining this motion electrically even when hand-rope control is in use. The time element during the process of acceleration is usually obtained by means of an air or oil dash-pot. To avoid the use of a dash-pot some makers adopt an air-vane geared up to run at a very high speed. There appears, however, to be still room for improvement." What is wanted is a quick movement from one stud to the next, and a prolonged pause on each stud. Some notes are given on breaking.—Lond. *Elec.*, April 7.

Electric Power in Shipbuilding Works.—The conclusion of the long illustrated article on the electric equipment of Harland & Wolff's shipbuilding works. Among the motors employed are some "ventilated but rain-proof" motors. The object of the design is to protect the motor from the intrusion of rain, metal shavings and other foreign bodies through the ventilation openings in the motors without making the motors totally enclosed, and so considerably increasing their size and cost, when the duty involves continuous running as in the case of machine tools. This protection simply takes the form of suitably shaped hoods fixed over the ventilation openings. The pressure of the current for the portable tools on the ships and in the fitting-out jetties and dock is reduced to 110 volts, this pressure being considered safer than 440 volts on account of the number of wandering cables and temporary connections which must of necessity be used. Moreover, as some of the installations of ships while being overhauled require to be fed at 60 volts and others at 80 volts, these lower voltages must on occasion be available. Current at these pressures is supplied from two motor-generator sub-stations, and the specification with regard to the voltage ranges and regulation of these is interesting. It is required that the generator part of these machines should be designed to give as far as possible, straight line terminal characteristics at three initial no-load voltages, namely, 60, 80 and 100 volts, and further that it shall be capable of being set to give various degrees of over-compounding up to 50 per cent rise between no-load and full load, the curves remaining as straight as practicable between their limiting points, whether the shunts are self-excited or separately excited, and between the speed range of 635 and 610 r.p.m. The adjustment of the overcompounding is arrived at by shunting the series field winding with resistance strips, the length of the shunt being adjustable by means of sliders. One striking feature of the works is the enormous gantry placed between two of the shipbuilding slips at the south end of the yard. The height over all is 185 ft., and the length from end to end 600 ft. A 5-ton double-cantilever crane extends 102 ft. on either side of the gantry, and can thus serve any part of the ships building on the two slips. The gantry crane and motors are of American make. In addition to the gantry cranes there are 33 electric traveling cranes of 5 to 50 tons capacity in the works.—Lond. *Elec.*, April 7.

Gas Power.—BOWMAN.—A long paper read before the (Brit.) Inst. Elec. Eng., in which the author first discusses the general principles of gas power, and the distinguishing features of pressure plants and suction plants. A pressure plant with bituminous fuel may be used for large units, say, of 1,000 hp. With a good bituminous plant and recovery of residuals and a modern gas engine developing 1,000 hp on a full-load, a brake-horsepower can be produced at a cost of less than 0.4 cent including everything, and a kw-hour for about 0.5 cent at the pole of the dynamo. With a pressure plant such as a Dowson, using anthracite or coke, a brake-horse-power-hour may be obtained for about 0.9 cent, including everything, and a kw-hour for 1.2 cents. All pressure plants, however, have one disadvantage—they require power to produce the blast necessary to force the air and steam through the system, and they require storage for the gas unless the requirements are perfectly uniform, which is never the case when the gas is used for power purposes. They require also a separate steam supply and experiments have proved that, when the best results are attained, about 16 per cent of the total fuel used is consumed in generating this steam. The gas being under presure, there is a liability to leakage, and as the gas has no smell and is of a highly poisonous character, serious accidents have happened, and pressure plants are quite unsuited to confined spaces. He then passes over to the discussion of the suction plant as first devised in 1888 by Benier. "The dynamic gas producer is the most perfect of its type, and when suitable fuel is employed, and the engine is properly constructed in regard to the proportions of its value, and to the compression of the gas before ignition, it is

at present the most economical source of power which can be obtained. The composition of the gas is practically the same as produced in a pressure plant using non-bituminous fuel, but it is much more regular and the calorific value can go as high as 155 B.T.U.; but its average value is about 150 B.T.U., being a mixture of producer and water gas. The engine and producer, however, in this suction plant being exactly suitable to each other, the engine has absolute control, not only of the quantity, but also the quality of the gas, and the regularity in the composition much exceeds that from any pressure plant." A plant recently erected in Yorkshire at the works of the Weldrivet Boiler & Motor Company, Halifax, supplies gas to a 60-hp gas engine, and the power, which is on the average about 30 hp to 40 hp, is distributed electrically. The cost per week of 54 hours with town gas at 62 cents per 1,000 cu. ft. was about $19.50. Since the suction plant has been installed, the cost of the anthracite coal has not exceeded $3.50 per week, or, rather, less than 0.2 cent per brake-horse-power. In a subsequent test lasting two days, by the use of a special mixture of fuel the cost of fuel per indicated horse-power was reduced to less than 0.07 cent. Some further figures are given on cost. The various advantages of the suction gas producer are summarized. The one disadvantage is that it cannot be worked on an absolutely light load for any length of time. The limit of satisfactory working on light load seems to be about one-fifth of the total load.—Lond. *Elec.*, April 7.

Superheating of Steam.—NEILSON.—Having reviewed in a former article the leading types of apparatus and modes of superheating, the author now discusses the results obtained by their use. The losses incurred by adopting superheating are, first, initial cost and up-keep of superheater, and, second, increased initial cost and up-keep of engines. Against this is the gain due to reduced coal consumption. If, with 150 degs. F. of superheat, the coal consumption be reduced from 1.5 lbs. to 1.275 lbs. per brake-horse-power per hour, that is 15 per cent, the gain with an engine of 1,000 brakehorse-power working 2,500 full power-hours per year will be 251 tons. With a good design and arrangement of superheater and a suitable engine, this gain ought easily to wipe out the losses due to the interest on the increased cost of the plant and the increased depreciation and cost of up-keep, and leave a substantial balance of net saving.—*Eng'ing. Mag.*, April.

Arrangement of Steam Pipes.—STROHM.—A well-illustrated article on the arrangement of steam pipes. The author treats of the various ways of allowing for the expansion of steam pipes, which are divided into two general classes: one in which the arrangement is such that the movement is taken up by the natural elasticity of the material, and another in which the movement is taken up by the use of expansion joints. Typical examples of each arrangement are illustrated and described.—*Amer. Elec.*, April.

TRACTION.

Railway Motor.—ARMSTRONG.—A discussion of the question whether a universal type of railway motor is advisable. The author points out that as the field of the railway motor has expanded, so the requirements of the motive power have become so varied as to make it difficult for any one motor system to meet successfully all the conditions imposed. He points out that the requirements for frequent stops in the service in cities are most exacting upon the motive power and its control, and the direct-current series motor and series-parallel controller may be looked upon as the survival of the fittest. The introduction of high potential alternating-current transmission to the converter sub-station made possible the suburban and interurban electric roads of to-day, and greatly broadened the possibilities of electric railroading. The change from a direct-current to an alternating-current motor is more radical, and is advocated only on account of the lesser first cost of the trolley distributing system, and is not due in any way to any superiority of the alternating-current motor itself. The author discusses the chief characteristics and limitations of three-phase induction motors and single-phase commutator motors. The induction motor is inherently a constant-speed, constant-duty motor, and does not possess the qualifications of a successful motor for rapid transit service. The single-phase commutator motor has thus far shown no indication of being superior or even of being equal to the direct-current motor, and when operated with an equal trolley potential seems to offer no advantages warranting its adoption. However, where the use of a high-potential trolley is permissible and stops are infrequent (conditions obtaining upon a suburban system having a private right of way) the single-phase motor offers claims for recognition which cannot be ignored. It adapts its speed to the grade, and in this respect is equal to the direct-current series motor, while the use of potential control gives the opportunity of continued operation at any speed called for by the profile of the road without impairing the efficiency of operation. With frequent stops, the heating due to the losses during accelerating is minimized, while the efficiency of the motors during free running is excellent. While the single-phase motor equipment offers no better or cheaper operation, it does permit of a considerable reduction in the first cost of installing a suburban system operating single cars on a private right of way, where the use of high potential on the trolley wire is permissible. Some notes are added on the question, which is still open, as to the best system for the heaviest character of street railway service.—*St. R'y. Jour.*, April 15.

Steel Tire versus Chilled Iron Wheels.—The annual report of the Liverpool municipal tramways. Concerning the wheels, the situation in July last was as follows: "The wheels of the German cars, which were the first to be used in Liverpool in 1898, were constructed with steel tires, and the wheels of the American cars which followed were of chilled cast-iron. The steel tire 'spread' in running, became loose and out of gauge, and ultimately were abandoned in favor of the solid wheel, which was giving much better results on the American cars. The British manufacturers commenced the production of special steel tires for tram cars in the year 1900, when their experimental use in competition with chilled wheels began. These experiments were carefully watched, and in May, 1902, a number of selected tires were placed in service in Liverpool. Later it was considered desirable to try tires of all the representative makers. Fifty-two of the cars are now fitted with steel-tired wheels, none of which has yet worn out, and, therefore, final figures cannot be quoted. Very divergent results have, however, been obtained, the mileage per unit of wear, varying to the extent of 50 per cent, indicating the importance of selecting tires of suitable composition. As a result of the experiments carried out for the last two years, a steel-tired wheel is now being assembled and finished at Lambeth road works which will cost 50 per cent. less than the price at which such wheels can at present be bought, and which, it is believed, will afford a life considerably in advance of the average of these wheels, which may be estimated at 60,000 miles, the average mileage of chilled wheels in Liverpool being 35,000. It is hoped that on trial this new wheel will be found suitable for general adoption." Since July, 1904, over 100 cars have been fitted with new wheels, which are giving satisfactory results, and the work of general equipment is proceeding. There are given statistical tables concerning the number of passengers, mileage and receipts. The percentage of operating costs to total revenue was 64.247 per cent in 1903 and 65.9 per cent in 1904. In 1903 the passengers carried per car-mile amounted to 9.66, but last year this figure was smaller by 0.08.—Lond. *Elec.*, March 31.

Wind Gauge for Railway.—An extraordinary accident occurred some time ago at the viaduct on the Furness Railway. During a violent gale, a train standing on the viaduct was actually blown over on its side. To avoid the possibility of any similar accident a wind-gauge and recorder has been installed, which closes an electric bell circuit when the pressure of wind blowing at right angles to the viaduct rises to 32 lb. per sq. ft. This has not happened for 18 months, the highest pressure during that time being 5 lbs. per sq. ft.—Lond. *Elec.*, April 7.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Time Element Thermal Cut-Out.—An illustrated description of a new type of thermal cut-out which acts only after the overload has lasted a predeterminable time. Its principal parts are a closed corrugated receptacle, *A*, of sheet metal, in form of a disc. containing a quantity of ether, and a small resistance coil placed underneath the ether receptacle, both being enclosed in a brass box, as shown in Fig. 1. The whole or part of the current in the circuit to be protected passes through the resistance coil, which begins at once to heat up, thus raising the temperature of the metal disc above it, and the coil may be so proportioned that its rise and fall in temperature with fluctuating current will be commensurate with the temperature variations in the electric apparatus it protects. When the overload comes on, the increasing temperature of the coil is communi-

cated to the hollow metal disc and to the other contained in it. The disc consequently bulges out and lifts a small piece of metal, which, in rising, first closes a bell circuit or a lamp circuit, and then, if the overload continues, actuates the trip gear of the main switch. By means of screw adjustments the time element may be varied within wide limits. The main switch cannot be closed again after being

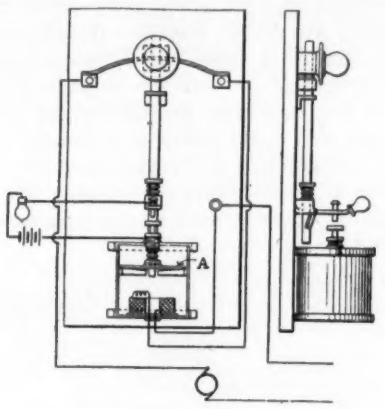


FIG. 1.—THERMAL CUT-OUT.

tripped until the resistance coil and ether disc have cooled down sufficiently. The device does not act, of course, instantly, even on a short circuit the shortest time being about 10 seconds.—Lond. *Elec.*, April 7.

Lightning Arresters.—NEESEN.—The author discusses the question whether a series connection or shunt connection of lightning arresters is preferable. The usual shunt connection is shown at the left-hand of Fig. 2, while the series connection is shown at the right hand.

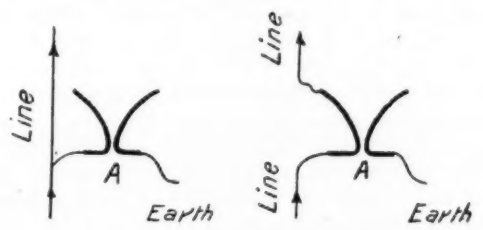


FIG. 2.—LIGHTNING ARRESTERS.

In experiments with various types of lightning arresters he found that series connection is more efficient than the shunt connection. The series arrangement was found to be especially efficient with two horn arresters made by two German companies. The reason why the superiority of the series connection over the shunt connection is different for different types of lightning arresters is to be found in the different self-induction of the different types. The author also made experiments on the insertion of a self-induction, but found that this is only an imperfect although sometimes useful remedy. The main point is to choose a suitable lightning arrester arrangement.—*Elek. Zeit.*, March 30.

Power and Lighting Equipment of a California Hotel.—WHITNEY.—An illustrated description of the engineering features of "The Potter" at Santa Barbara, Cal. The hotel has an independent water supply, and from its own power station are provided steam heating, hot water, electric lighting, power, refrigerating and drinking water services. The engineering details of these installations, as well as other features of mechanical and electrical interest which have been provided for the safety and convenience of guests and employes, are described.—*Amer. Elec.*, April.

Electric Equipment of Steamships.—A description of the electric equipment of two vessels, which is stated to be fairly typical of the present practice with regard to small and medium-sized steamers for cross-channel service. In addition to electric lighting the vessels are fitted with electrically driven fans for forced draft, and also for the hot-air heating system and ventilation.—Lond. *Elec.*, March 31.

WIRES, WIRING AND CONDUITS.

Insulation Resistance of High-Tension Cables.—HUMANN.—An account of tests of the insulation resistance of high-tension cables insulated with impregnated paper. To produce a very high insulation resistance the impregnating materials are generally of such a nature that the insulating layers get stiff and brittle. This should not be the case, since a break in only one layer of impregnated paper may start the breakdown of the whole cable. It is necessary for practical purposes to make the insulating layer as soft as possible, so that the cables may be bent without danger. This is possible only when the impregnating materials consist mainly of oils. While thereby a smaller insulation resistance is obtained, yet the cables become safer for practical use. The author shows that it is wrong to assume that a high insulation resistance diminishes the losses in a high-tension cable. If a cable is properly dried he finds that the losses are practically independent of the insulation resistance. However, these losses increase very materially in cables with low insulation resistance if they have not been perfectly dried. The author recommends never to attempt to get more than 1,000 megohms per kilometer at 15 degs. C. He also emphasizes that a cable of 300 megohms may have the same good properties as one of 1,500 megohms. On the other hand he considers specifications of more than 1,000 megohms as absolutely unsuitable. Measurement is made of the insulation only for the purpose of determining whether a cable contains a fault.—*Elek. Zeit.* March 30.

Taping.—STEPHENS.—After a few remarks on the purpose of taping, the author discusses the properties of different kinds of taping. Generally speaking, there are three kinds of tape—untreated cloth, rubber and treated cloth. Untreated-cloth tape may be of any fabric, such as linen, cotton or silk. When this tape is kept perfectly free from moisture it forms a good insulation. Its chief advantage, however, is its mechanical strength, which admits of rough handling during the taping process. After it is in place, it is usually treated by brushing with or dipping in varnish or some other insulating compound. This increases the dielectric strength, and prevents the absorption of moisture. Rubber tape may be divided into two general classes: first, those tapes without any cloth or other supporting body; second, those with some supporting body. The first class of rubber tape is made up from a rubber compound. It is relatively thick, but being quite elastic, the operator is enabled to obtain varying thicknesses by stretching. It is best adapted where the voltage is high and where there is plenty of room for insulation. In splicing rubber-covered cables, this tape secures for the splice practically the same insulation as is on the body of the wire. The second class of rubber tape may be obtained in a variety of forms, the most common of which are viscous tapes. These tapes are sticky at ordinary temperatures. They adhere readily, and after drying for some time become quite hard and offer considerable mechanical support. Viscous tapes vary considerably in thickness and cost, depending on the materials used in their manufacture. Treated or varnished-cloth tape may be sticky, or it may have a smooth, hard surface. It usually requires some binding material to hold it in place. Its insulating property is very high, and being very thin it is well adapted where space is valuable, especially for insulating wires in slots of machines. However, it is not very strong mechanically, and should not be used on rough or uneven surfaces, or where it is likely to be subjected to mechanical strains. A tape joint should be moisture proof. To insure this, the tape should be wound very firmly. Some practical hints are given on taping a splice and on soldering a cable to a solid conductor.—*Elec. Club Jour.*, April.

Line Calculation.—LEGROS.—A paper illustrated by diagrams on the calculation of an electric distribution network.—*LEclairage Elec.*, March 25, from *Schweiz. Elek. Zeit.*, 1904.

ELECTROPHYSICS AND MAGNETISM.

Mercury Vapor Rectifier.—LODGE.—A lecture before the British Royal Institution on what he calls "a pertinacious current," which is "a continuous undirectional discharge of electricity, obtained without cells, and under an e.m.f. so high that ordinary big resistances are easily over-ridden." He uses such a current in his experiments on fog dispelling. His method consists in using the mercury rectifier to "trap in a reservoir the surves from an induction coil." He proposes a new theory of the vacuum-tube rectifier. According to him the current is carried through a rarefied gas chiefly by the positive particles, the electricity conveyed by the negative particles or corpuscles being comparatively small in amount. Anything which hinders the passage of the positive ions increases the effective electrical resistance of the tube. The cathode rays usually render the conduction difficult. This theory explains the necessity for using the conducting coating outside the glass and round the edge of the liquid mercury which acts as cathode at the bottom of the tube. This conducting Leyden-jar-like coating must be connected to the positive

electrode by a wire outside the tube or the tube is not a rectifier. The explanation is that the conducting coating when so connected establishes through the glass a strong electric field which diverts the cathode stream from the centre of the vertical tube, leaving an open pathway for the positive carriers from the anode above. It is easy now to see why the tube is a rectifier, for if the outside terminals be imagined reversed, so that the mercury is anode and the upper iron electrode is cathode, a stream of undiverted cathode rays pours down the tube, stops the upward travel of the positive carriers, and renders conduction extremely difficult. This theory suggests new and efficient forms of rectifiers. One such was described and exhibited.—Lond. *Elec.*, March 31.

A New Vacuum Rectifier.—FLEMING.—A description of an electric vacuum valve which enables him to convert electric oscillations, however rapid, into continuous currents, with an efficiency approaching 100 per cent. This valve is of great use as a quantitative indicator of electric waves, though the fact that the resistance of the vacuum does not obey Ohm's law makes the apparatus imperfect in this respect. The inventor utilizes the fact that electrons are expelled with ease from an incandescent conductor, but are not absorbed by it. Hence, a current of electrons will proceed from a hot terminal to a cold terminal (or, in the older style of description, a "current" will pass from the cold to the hot terminal), but not in the opposite direction. The cold terminal is a metallic cylinder kept cold by a circulation of water, while the hot terminal is a filament heated to incandescence. The connections are indicated in Fig. 3. If both phases of the incident

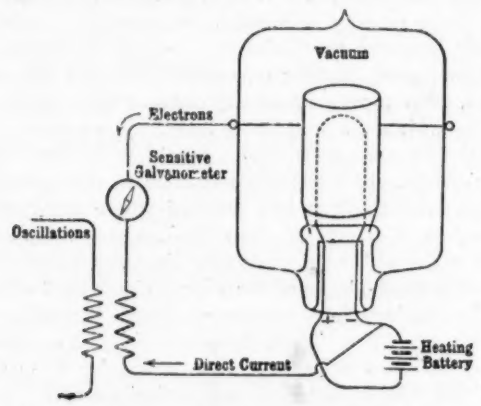


FIG. 3.—VACUUM RECTIFIER.

current are to be rectified, two valves must be used, as in the case of the aluminum rectifier. The vacuum space enclosing the two terminals possesses a maximum conductivity corresponding to a p. d. of about 20 volts.—Lond. *Elec.*, March 31, from *Proceedings Roy. Soc.*, March 16.

Radiation.—CAMPBELL.—Two papers giving the results of experimental investigations. In the first he discusses the radiation from ordinary materials, his main results being as follows: The influence which the walls of a containing vessel are known to exert upon the spontaneous ionization of the enclosed air may be attributed to a radiation proceeding from the walls. Part of this radiation from certain materials such as tin, zinc, graphite and platinum, is analogous to the secondary radiation excited by Roentgen and other rays, being caused by the penetrating ionizing rays which Cooke has cut off with thick lead screens. The absorption coefficient of air for this radiation is comparable with that of air for the alpha rays from radium. The absorption coefficient is different for different materials, and hence it is unlikely that the radiation is due to radioactive impurities. It is more probably an inherent property of the material. It is suggested that all elements are radioactive to some degree. There is no evidence of the existence of rays from ordinary materials of a penetrating power considerably greater than that of the alpha rays from radioactive elements. In this investigation the author noticed the effect of cleaning the surface of a metal on the intensity of the rays emitted from it. It was found that mechanical cleaning with sandpaper did not produce a change, but that an increase in the ionization caused by a metal was brought about by cleaning the surface with an acid that dissolved it. This observation suggested that chemical action might be attended by the emission of ionizing rays, and further experiments were made. The results are given in his second paper, and show that there is no evidence that chemical change is accompanied by radioactivity. The increase in the spontaneous leak, the observation of which has led some investigators to suggest such a connection, is due to the heating of the walls of the vessel. The nature of the relation between the heating and the increased leak requires further elucidation.—*Phil. Mag.*, April.

Electric Charge of Radium Emanation.—BATTELLI and MACCARONE.—An account of experiments in which they found that electrons may be projected from a positively charged electrode under certain conditions. He takes a Crooke's tube as constructed for exhibiting the shadow of a cross exposed to cathode rays. But he reverses the connections, so that the cathode becomes the anode. The Ruhmkorff coil furnishing the current has a spark of some 4 cm. The resistance of the primary is increased till the coil nearly ceases working. The shadow of the cross then appears on the wall of the tube in the well-known manner, although an electroscope still indicates a positive charge on the anode.—Lond. *Elec.*, March 31, from *Comptes Rendus*, Feb. 21.

Radium Rays and Phosphorescence.—BEILBY.—An account of an investigation in which he studied the phosphorescence caused by beta and gamma rays of radium in order to trace the connection between the chemical and coloration effects and the luminescent effects of the rays.—Lond. *Elec.* March 31.

Radiation Pressure.—POYNTING.—His address in full, an abstract of which was recently noticed in the Digest.—*Phil. Mag.*, April.

ELECTROCHEMISTRY AND BATTERIES.

Nickel Iron Alkali Battery.—SIEG.—A paper read before the Elec. Soc. of Cologne. The author is the director of the German storage battery manufacturing company which owns the Jungner patents for the nickel-iron alkali storage battery (Edison battery). He describes the difficulties which they have had in developing the battery, and states that they have given up, for the present, the hope of developing a battery which is superior or only equal to the lead cell with respect to lightness. They have, however, developed a nickel-iron cell which is superior to the lead cell with respect to fool-proofness and long life even with very bad treatment. This battery gives 10 to 12 watt-hours per kg. For automobile purposes, they are now placing a lead cell on the market which gives 34 watt-hours per kg., and which is even cheaper per watt-hour than the more heavy types of lead cells. He thinks the development of the lead battery for automobile purposes is not yet at an end.—*Elek. Zeit.*, March 30.

Electric Furnace.—HUTTON and PATTERSON.—An illustrated Faraday Soc. paper, giving details of construction of electrically heated carbon tube furnaces. One of the great advantages of such furnaces over those in which the heat is obtained from an electric arc, or from a granular resistance material, lies, according to the authors, in the fact that the temperature can be much more easily regulated and kept constant. It is therefore especially suitable for many physical and chemical investigations.—Lond. *Elec.*, April 7.

Electrolytic Solution of Platinum in Sulphuric Acid.—BROCHET and PETIT.—An account of experiments which show that while platinum does not dissolve in sulphuric acid when simply immersed in it or when used as an electrode with the passage of a direct current, yet it dissolves with the passage of an alternating current or a pulsating current. —Lond. *Elec.*, March 24; from *Comptes Rendus*, March 6.

Non-Aqueous Solutions.—FRANKLIN and KRAUS.—A long account of an extended investigation in which the authors measured the conductivity of numerous substances in liquid ammonia solutions.—*Jour. Am. Chem. Soc.*, March.

TELEGRAPHY, TELEPHONY AND SIGNALS.

First Pupin Telephone Line in Austria.—NOWOTNY.—An illustrated article on the first Pupin telephone line in Austria, which connects Vienna with Innsbruck, the distance being 570 km. An ordinary telephone line would have required a bronze wire of a diameter of 4 mm., while with the Pupin system a bronze wire with a diameter of 3 mm. is sufficient, which means considerable saving of the first cost of installation. The transmission line comprises somewhat over 5 km. of underground cable. Pupin coils were inserted on the overhead line at intervals of 4 km. in both wires, each coil having a resistance of 1.2 ohm and a self-induction of 0.08 henry. The coils inserted in the cable line were constructed differently, and were placed at distances of 1,250 meters, having a resistance of 2.5 ohms and a self-induction of 0.2 henry. The way

in which the coils were inserted in the lines is shown in Fig. 4. The short-circuiting device between *m* and *n* was used in order to make experiments on the efficiency of the Pupin system. It was

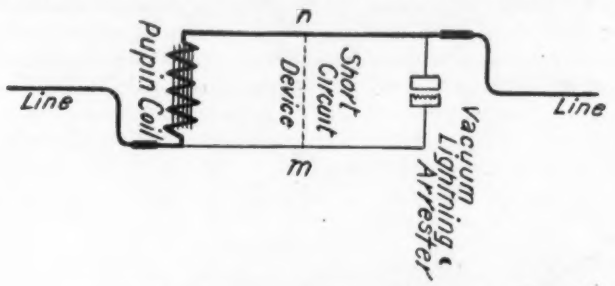


FIG. 4.—METHOD OF INSERTING COILS ON LINES.

thus possible to short-circuit any number of Pupin coils. The system was found to be quite successful, although it was found that half the number of coils were about as effective as the total number of coils. Some theoretical considerations are given, and it is said that the question of the most economical insertion of induction coils in overhead lines needs further study.—*Zeit. f. Elek. (Vienna)*, March 25.

Electrolytic Wave Detectors.—VALBREUZE.—A note on the action of electrolytic wave detectors. He sums up especially the recent investigations of Ives and of Rathmund and Lessing, and concludes that the action in the detector is a polarization phenomenon, although further extended studies are necessary to determine exactly the operation and theory.—*L'Eclairage Elec.*, March 25.

Automatic Block Signals.—SCOTT.—The continuation of the series on automatic signals, this one illustrating and describing the standard electro-gas signal construction, together with the gas valve.—*Am. Elect.*, April.

BOOK REVIEWS.

LA BOBINE D'INDUCTION. By H. Armagnat. Paris: Gauthier-Villars, 223 pages, 109 ills. Price, 5 francs.

This little book gives a very complete discussion of the properties of induction coils. The treatment is almost exclusively descriptive, very few mathematical equations being included, the exceptions noted referring particularly to oscillating currents due to condenser discharges and counter charges attending the use of mechanical and electrolytic interrupters. Instructions are given as to the construction of coils and as to the proper methods of testing. A considerable portion of the book is devoted to interrupters and their defects. A few of the high-frequency, high-potential tests due to Tesla are briefly described. Various practical applications of the induction coil are noted in connection with the experiments of Crookes, Geissler and Röntgen. The concluding chapter contains a comprehensive bibliography which gives not only reference to numerous articles which have appeared in technical publications, but also in many cases an indication of the nature of the article itself.

LABORATORY AND FACTORY TESTS IN ELECTRICAL ENGINEERING. By Geo. F. Sever and Fitzhugh Townsend. New York: D. Van Nostrand Company. 236 pages, 97 ills. Price, $2.50.

This volume is intended primarily as a textbook for the use of students, and it represents the laboratory work required in the electrical engineering course at Columbia University. It is admirably arranged for the purpose intended. The subject matter is treated in three parts, designated as direct-current tests, alternating-current tests and electrical measurements. Under each of the first two parts there is a further division into commercial tests and illustrative and special tests. The third part deals with the measurement of hysteresis, calibration of integrating meters, characteristics of storage batteries, photometry of lamps and similar tests.

For each test there are given sufficiently complete instructions as to the method to be pursued, a diagram of connecting circuits, suggestions concerning the tabulation of data and curves for indicating the results to be expected. The text is notably free from "padding" and repetition, the tests described being confined to those which would be made regularly in any well-equipped college laboratory. There is given only that amount of theory necessary to indicate to a student already familiar with fundamental electrical principles just what the test is intended to show. The authors have well succeeded in eliminating all extraneous matter, and in including all that is essential to a textbook for an engineering laboratory.

The Morrison Storage Battery.

The Universal Electric Storage Battery Company has recently been organized in Chicago to manufacture a battery which is the invention of William Morrison, a well-known storage battery expert of that city. Details of the plates of this battery, which are of the built-up type, are shown in Figs. 1 and 2. Fig. 1 is a completed plate, and Fig. 2 shows the various parts appearing in the order in which they are assembled. The part numbered 1 in Fig. 2 is a solid piece of lead alloy metal to which the terminal is attached. The active material is held in a kind of frame or case, numbered 4. On each side of this frame are porous retainers of treated paper. A wood separator, 3, goes between the cases of active material and allows the electrolyte to circulate freely. In Fig. 3 the part numbered 4 is the lead alloy frame, and 5 is the same frame filled with active material. These active material cases dovetail into grooves in the

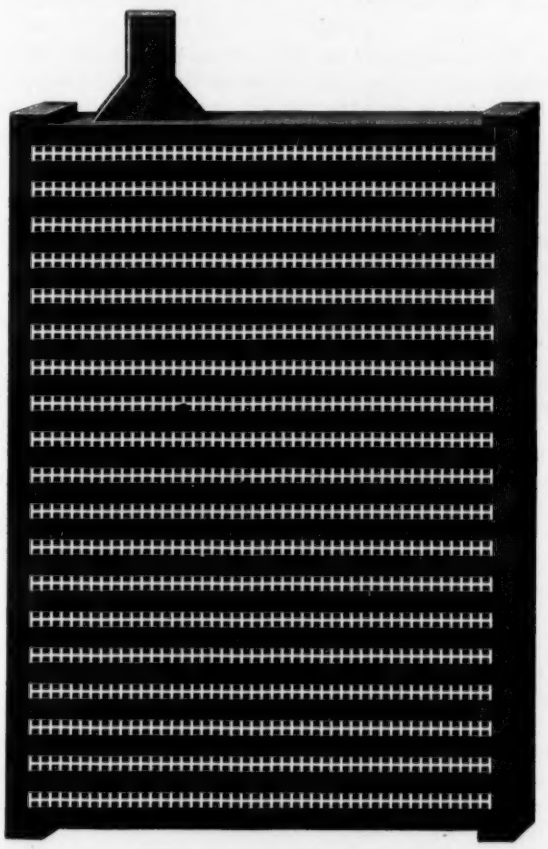


FIG. 1.—PLATE COMPLETE.

vertical side frames of the assembled plate. The side frames are bent over at the ends to hold the plate together. It is thus seen that the plate consists of a number of trays of active material exposed on both upper and lower sides to the action of the electrolyte which can circulate through the openings of the grooved separators between the various trays. The surface exposed to the electrolyte is thus very large compared to the size of the plate.

Following is an abstract of Mr. Bain's report on a cell of this type which he tested: The outside dimensions of this cell, consisting of 7 positive and 8 negative plates, were 11¾ by 7¾ by 6⅝ in. The supporting plates were of lead alloy, and the active material oxide of lead. The electrolyte of sulphuric acid and water as prepared by Mr. Bain, had a specific gravity at the start of 1.3. The elements when piled up measured 9 by 7½ by 6 in. The dimensions of both positive and negative plates were 8½ by 6½ in. The total weight of the cell was 66 lbs., of which 56½ lbs. were in the elements and connectors, 3¼ lbs. in the case and 6¼ lbs. in the electrolyte. The positive plates had 20 cross bars and 19 intervening separators. The area of active material exposed to electrolyte on one plate was 96.4 sq. in.

The cell was rated at 450 ampere-hours. The energy per pound

of cell at the normal rate of discharge was 16.8 watt-hours, and at a high rate (2¾ hours) of discharge. 13 watt-hours. The internal resistance of the cell when charged was .001 ohm. At a 20-hour charge and discharge rate, the current efficiency was 90.8 per cent and the watt efficiency 83.66 per cent. At a 5½-hour charge and a 2¾-hour discharge rate, the current efficiency was 74, and the watt efficiency 60

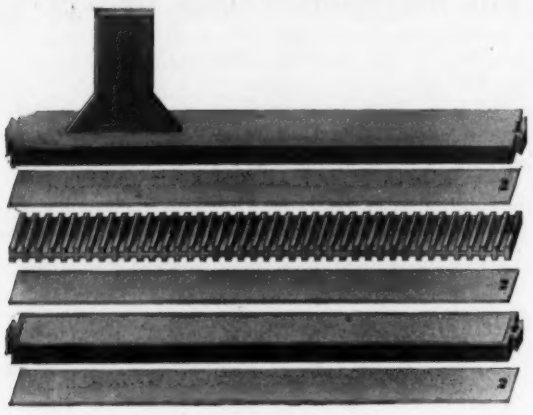


FIG. 2.—PARTS OF PLATE.

per cent. Being requested to subject the battery to all the misuse that it might receive in practical service, Mr. Bain charged the cell at a 15-hour, 13-ampere rate. He then short-circuited it with two copper strips 1½ inches wide and .025 inch thick. The copper strips were heated until they became luminous, and remained so for some time. The cell was kept on short circuit about 40 minutes, or until it became completely inert. It was then charged at a 15-hour rate and discharged at a 30-hour rate until the voltmeter stood at zero.

A test was then begun which consisted of charging for seven hours and forty minutes, and discharging until the voltage fell to 1.8, the discharge taking 18 hours and 50 minutes. The watt efficiency in this test was 70.3, which Mr. Bain considers remarkable considering that the discharge was only to 1.8 and the charge was from zero voltage. Later tests gave the figures quoted earlier in this article. Several more charges and discharges were made by Mr.

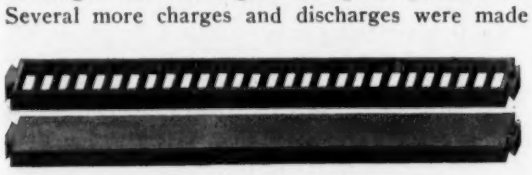


FIG. 3.—LEAD ALLOY FRAME.

Bain to determine the efficiency and general performance of the cell. After the tests the cell was taken down and found to be in excellent condition.

The Universal Electric Storage Battery Company is equipping a large factory to make these batteries under the direction of the inventor. The president of the company is A. F. Callahan, and vice-president, J. S. Burnet. The offices are in the Railway Exchange Building, Chicago.

Exhibits of the Westinghouse Companies at the International Railway Exhibition.

The Westinghouse building at Washington is the largest structure on the grounds of the International Railway Exhibition, apart from the headquarters building devoted to the grouped displays of the smaller exhibitions, and presents in an attractive and orderly arrangement one of the most remarkable displays of Westinghouse products ever brought together under a single roof. The brake and coupler appliances of the Westinghouse Air Brake Company and its associated interests are shown under conditions approximating those of actual practice. The Union Switch & Signal Company has installed full-size safety apparatus of all standard types. The Westinghouse Electric & Manufacturing Company exhibits for the first time complete operative equipments of its latest forms of multiple-control systems for alternating-current and direct-current traction, with important auxiliary sub-station apparatus, and displays also an interesting collection of heavy railroad shop tools driven with Westinghouse motors. The Westinghouse Machine Company has set up, open for inspection, a 600-hp steam turbine identical in size and type with the Westinghouse turbines that ran continuously for 3,962 hours at the St. Louis Fair. Nernst lamps and Cooper Hewitt lamps peculiarly adaptable, respectively, for decorative passenger station and train illumination, or for economical terminal shed and tool shop lighting, are used liberally throughout. The dome of the building is lighted with four big electric signs which flash the name

WESTINGHOUSE EXHIBIT BUILDING.

Westinghouse to a great distance, and large banners at the entrances carry the names of the twenty-six Westinghouse companies of the United States and Europe represented in the joint display. Mr. Frank S. Smith, one of the resident Westinghouse commissioners at the Louisiana Purchase Exposition, is the managing director, and Mr. C. W. Townsend is in immediate charge of the installations of the Air Brake Company.

New Westinghouse Apparatus.

When a group of arc lamps are connected in series across a circuit, the drop across the lamps seldom equals the difference of potential between the lines, and it is, therefore, necessary to introduce a regulating resistance. The accompanying illustrations show the resistance which the Westinghouse Company uses with its direct-

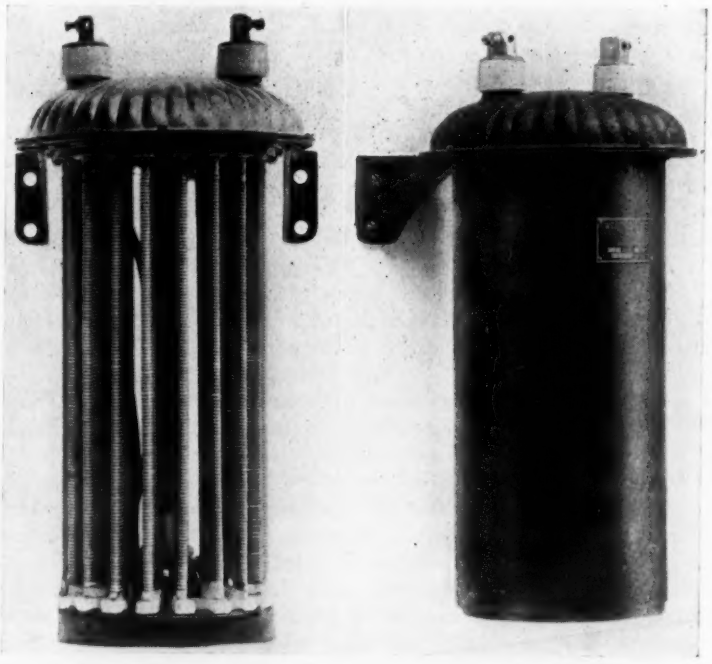


FIG. 1.—ARC LAMP RESISTANCE.

current multiple and series-multiple lamps. One resistance is used with two lamps in series on circuits of 220-250 volts, and with five lamps in series on 550-600-volt circuits two resistances are used. The successful operation of such a system requires that the resistance be reliable in every particular, for it is noteworthy that to a very great extent poorly designed and cheaply constructed accessories are responsible for the troubles in electrical installations.

Recognizing this fact, the above company has developed and placed upon the market this resistance, which may be suited to a varying range of conditions. It is well insulated and thoroughly waterproof, besides having a neat appearance. The wire furnishing the resistance is wound on asbestos-covered bars, which are insulated from the frame by porcelain blocks. This combination of asbestos and porcelain affords protection against fire. A terminal block at the bottom furnishes means for adjustment, so that five different resistances may be obtained by merely changing these connections.

The case and cap are finished in black. The binding terminals are insulated from the metal top by heavy petticoated porcelain insulators; both the terminals and insulators have square stems which prevent them from turning and becoming loose, or twisting off the connections. By means of substantial brackets just under the cap, the assembled outfit may be fastened with screws to the wall or other suitable support. The weight of the resistance complete is 30 pounds.

The Westinghouse Electric & Manufacturing Company is placing upon the market a recently developed type of watt-hour meter for

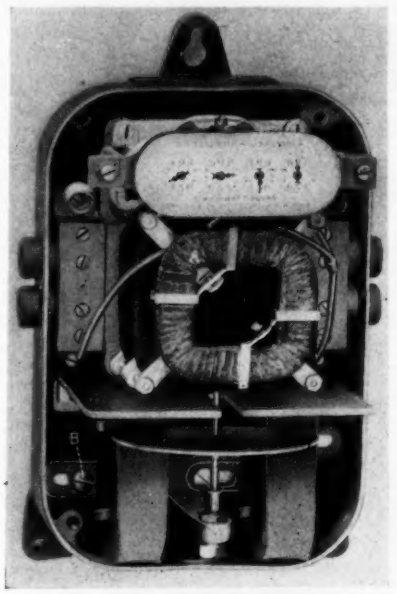


FIG. 2.—INTEGRATING WATTMETER.

direct-current service, which embodies in its construction many of the special features which experience has shown to be advantageous with integrating meters of the alternating-current type. A view of the interior of the instrument is shown in the accompanying illustration. When the cover is removed, the adjustments can easily be made, since they are wholly mechanical, and do not depend upon variable resistance or similar arrangements. To compensate for friction there is moved in or out the shunt coil, which is held in position by two screws. The speed of the disc is controlled by two permanent magnets. Under any given load, the act of moving the magnets in from the edge of the disc increases the speed, and moving them out towards the edge decreases the speed. Releasing the adjusting screws, one of which is shown at *B* in the illustration, permits the magnets to be moved as desired.

One of the most important parts of direct-current watt-hour meters is the commutator. In the new instrument the commutator is built of non-oxidizing metal, and is given a diameter of only 5-64 of an inch, so as to insure a reduction of friction to a very low and constant value. Even a perfect commutator is ineffective, however, without suitable brushes. Perfect contact with the least amount of friction must be maintained, and the material must be such that oxidation will not take place. The brushes in this meter are composed of a number of strands of wire of non-oxidizing material. This subdivision of the brush gives an excellent contact, as each strand is thereby made a separate brush, and the strands conform exactly to the surface of the commutator with a minimum total tension, insuring ideal working conditions.

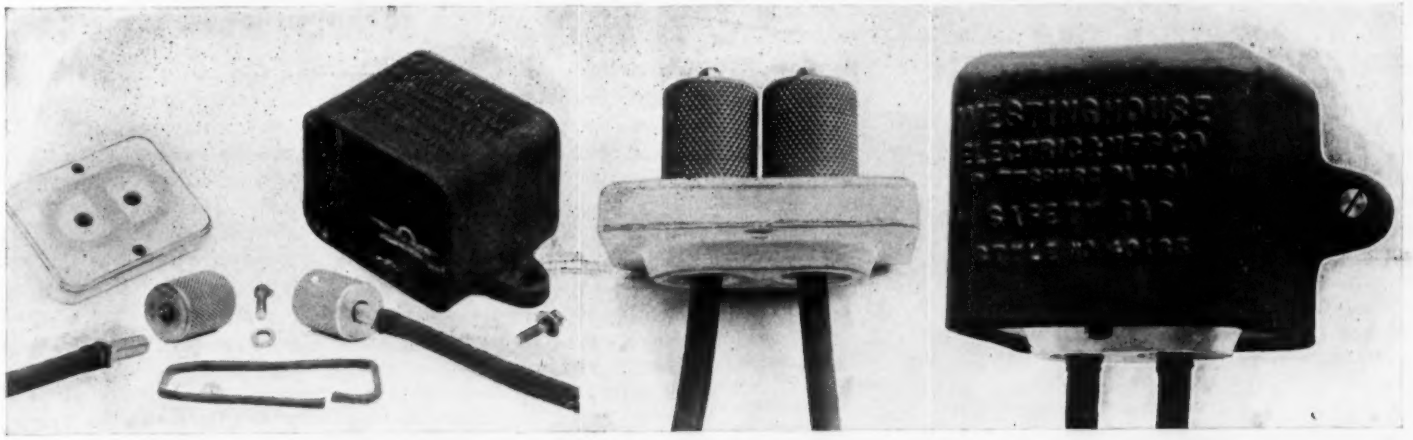
The shaft of the meter terminates in a removable sleeve with a slightly cupped sapphire jewel which rests upon a hardened-steel ball 1-16 inch in diameter. This ball is supported by a second jewel, similarly cupped, which is set in the end of the adjusting screw which forms the lower half of the bearing. The lower jewel is spring mounted, which construction effectually protects it from sudden jar.

The terminals enter at the sides, passing through the case, the line-wires being connected on the right-hand side of the meter and the load-wires on the left. The bushings form a close junction with the terminal blocks, and make the case proof against insects and moisture. The case is finished in black enamel, with letters in low relief. In general appearance the new instrument resembles the Westinghouse alternating-current watt-hour meter.

For some years the Westinghouse Electric & Manufacturing Company has had on the market a piece of apparatus designated as a "spark-gap protector for a secondary circuit." The name "spark-gap," although not incorrect, does not suggest the application of this device, and the name has been changed to "safety gap," since its function is to provide a safety gap or path for the escape of high-potential current from a low-potential system. The gap first mentioned as being on the market for some time is intended only for indoor use, though the electrical operation of the two types is the same.

The purpose of the safety gap is to protect the low-tension windings of a transformer against any abnormal rise of static potential, occasioned by grounds, switching of the high-voltage lines, etc. This type is particularly applicable to local lighting and power service, and can be adjusted for a wide range of voltages.

The safety gap with cover removed is illustrated in Fig. 4. The gap across which the arcing occurs is here clearly shown. The appliance is neat and substantial in construction, occupies a minimum amount of space, and is well insulated and rainproof. The cylinders are made of non-arcing metal, may be adjusted for any size gap by merely loosening a screw at the top of the cylinder, and may be turned as desired so as to present new surfaces for action. A porcelain base supports the cylinders and the whole is enclosed in a cast-iron box, as shown in Fig. 5.

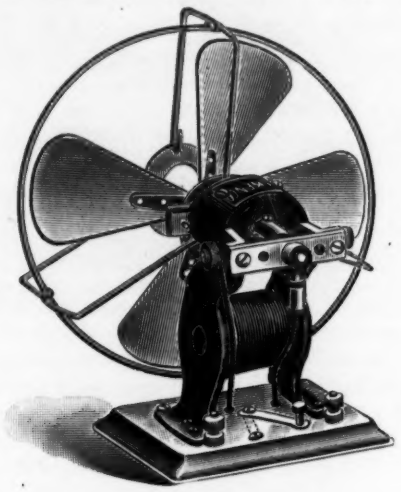


FIGS. 3, 4 AND 5.—SAFETY GAP.

In order that a good idea of the different parts which go to make up the complete device may be obtained, the details are shown in Fig. 3. The construction is somewhat similar to that of the new Type C Westinghouse lightning arrester. All parts are removable and can be assembled without difficulty.

A Dry Battery Fan.

The Knapp Electric & Novelty Company, 511 West Fifty-first Street, New York, is placing on the market a fan motor designed especially to be run from a battery of dry cells. Notwithstanding the remarkably small face of the fan, it is constructed along the lines of the best motor design. The armature, which is of the slotted drum type, is built up of laminations. It is fitted with radial gauze adjustable brushes, automatic feed oil cups and a starting



DRY BATTERY FAN.

switch. A box for twelve dry cells is included with the motor. With three cells in series and four multiples the draft of current is so reduced that the cells keep up to voltage. Twelve cells connected as above will, it is stated, give, when running three hours per day, a total service of 200 hours. The fan is six inches in diameter, and runs at 1,000 r.p.m.

Inter-Pole Motors at the International Railway Congress.

The Electro-Dynamic Company, of Bayonne, N. J., has secured spaces 1 and 2 in Section O in the main exhibition building at the International Railway Congress, to be held in Washington from May 3 to 13, and will exhibit in these spaces one of its type 5-S, four-to-one Inter-Pole, variable-speed motors belted to a generator. With this motor it will be able to show the operation of the Inter-Pole motor under varying conditions of speed from 275 to 1,100 r.p.m. and all loads from no load to 100 per cent. overload. The motor will be reversed under all of the above conditions of load and speed with results, it is claimed, which have never been obtained heretofore in the operation of electric motors, either for constant or variable-speed work. There will also be on exhibition different sizes of motors running from one horse-power at a speed ratio of four to one up to ten horse-power having the same speed ratio and a similar overload capacity of 100 per cent.

There will be exhibited a total of 19 variable-speed motors and 22 constant-speed motors, also the following constant-speed motors, ranging from 1 to 30 hp.

H.P.	Rev. per minute. 110 and 220 V.	500 V.	Type No.	Net weight.
3	375	425	3-S	720
3	600	675	2-S	540
3	1275	1425	1-S	415
5	325	375	5-S	915
5	600	650	3-S	720
5	1200	1300	2-S	540
7½	325	375	7½-S	1295
7½	500	550	5-S	915
7½	925	1000	3-S	720
10	325	365	10-S	1680
10	500	550	7½-S	1295
10	700	775	5-S	915
10	1100	1200	3-S	720
15	500	550	10-S	1680
15	700	775	7½-S	1295
15	1000	1100	5-S	915
20	700	775	10-S	1680
20	1000	1100	7½-S	1295
30	1000	1100	10-S	1680

The motors will cover one hundred and twenty-three distinct varieties, which will enable a user of motors an opportunity for choice which has never heretofore been equalled.

The Electro-Dynamic Company is rapidly enlarging the scope of operation for the Inter-Pole motor, and will, within the next several months, be prepared to sell at least two hundred varieties of constant and variable-speed motors running up as high as 150 hp.

In addition to the above exhibits, a 5-S variable-speed motor having a speed ratio of four to one, will operate the electric car lighting equipment of the Consolidated Railway Electric Lighting & Equipment Company, whose exhibit is located in spaces 9, 10, 11 and 12 in Section O, and a motor with a capacity of 10 hp at a speed ratio of two to one will drive a vertical turret lathe in the exhibit of the Bullard Machine Tool Company.

Lamp Cord Holding Device.

The need of a fastening device to prevent cords being pulled out of their terminals has led Keough Bros. & Co., 79 North Street, Boston, to put on the market the device shown in the accompanying illustration. It consists of a neat brass shell for attachment to sockets, rosettes, pendant switches, attaching plugs, etc., containing a porcelain ball. The porcelain ball is inserted after the connections are made, then by screwing the cap a bushing is forced down and holds the cord fast as it curves around the ball. This device permits the use of a ⅛-in. instead of a ⅜-inch socket where large cable cord is used.

LAMP CORD HOLDING DEVICE.

New Equipment for Worcester Electric Light Co.

In addition to the equipment described in our issue of December 17, 1904, the Worcester Electric Light Company has recently contracted for an extensive boiler plant to take the place of the boilers which have been in service at the Faraday Street station for the past fifteen years. A new stack will also be erected. The old boiler plant, which consists of 10 Allen horizontal, return tubular boilers, 72 in. in diameter, with 16-ft. tubes, is to be entirely replaced by about 3,000 hp in two batteries of Stewart horizontal return tubular boilers, 12 in total number, with 84-in. diameters and 18-ft. tubes, built for 165 lbs. steam pressure. The old stack will be retained, its dimensions being 72 in. square by 140 ft. high.

The shell plates of the new boilers are to be 9-16 in. thick on the edges, of open-hearth steel, with a minimum tensile strength of 60,000 lbs.; ductility not less than 56 per cent on elongation of 25 per cent in 8-in. test pieces. The heads are to be ⅝ in. thick, and there is to be not over .025 per cent. of sulphur or over .03 per cent. of phosphorus in the plates and heads. The longitudinal seams are to be of the quadruple-riveted, butt-joint type, arranged to come well above the fire line. The girth seams are to be of the single inverted lap-joint type, the rivets being pitched 2¼ in. on centers. Rivets are to have a shearing resistance of not less than 42,000 lbs. and a tensile strength of at least 52,000 lbs., and a minimum elongation of 30 per cent in a length of 8 in. There are 40 1⅜-in. braces in each boiler. Each boiler will contain 138 3½-in. tubes, and an 11 by 15 in. manhole. The smoke openings are 16½ in. by 72 in., and the feed and blow-off pipes 2 in. wide each. Steel fronts are to be used. These will be placed flush with the walls, in order to facilitate cleaning. This method of construction results in a decided improvement in comparison with the old plan of brick and cast-iron fronts.

The new stack will be erected on a concrete foundation at the east end of the boiler house. It will be of Alphons Custodis construction, 165 ft. high and 7 ft. inside diameter. The lower 30 ft. will be of hard-burned red brick, and the upper 135 ft. of a round column of hollow radial moulded blocks of circular section. The blocks are to be 6½ in. by 4 in. deep on their external faces. A cast-iron cap will surmount the stack, and ⅝-in. step irons 18 in. apart will be installed in the interior.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Excellent reports were received of trade, which is expanding in a wholesome manner. The most encouraging indication regarding the future is the scarcity of labor disputes. Jobbers have experienced a good spring trade, and manufacturers are now receiving large contracts for fall shipment, while retail sales are of satisfactory volume, except at a few points, where inclement weather has temporarily retarded distribution. Activity at the interior is evidenced by the increased transfers thither of silver dollars and subsidiary silver by the Treasury, crop prospects being well maintained despite excessive cold in a few sections. Railway traffic continues very heavy, earnings for April thus far exceeding the same period last year by 10.7 per cent, while foreign commerce at this port for the last week shows a gain of $3,834,447 in value of merchandise imported, and an increase of $1,947,550 in exports as compared with 1904. Mercantile collections show further improvement, and money remains abundant and easy. Prices of many staples have been weak and unsettled and cereals, cotton, some kinds of pig iron and copper have moved lower. Official copper quotations declined about ¼c., Lake and electrolytic being sold at 15c. to 15¼c., and casting stock 14¾c. to 15c. Buying of copper has not been stimulated by the reduction in price and the market was very dull. Finished iron and steel are in good demand, particularly in the West. A heavy Lake movement in ore has begun, and the strike in the Iron Range country has ended. *Bradstreet's* reports 193 business failures during the week ended April 27, as compared with 183 the week previous and 197 the corresponding week last year.

RECENT JAPANESE ORDERS.—The Japanese engineering and contracting firm of Takata & Company has just placed, through its New York office, 10 Wall Street, an order for a 1,000-hp turbine, with Jas. Leffel & Company, Springfield, Ohio, which will be used under a 75-foot working head. For the control of this turbine, a Lombard improved type "D," oil-pressure, quick-acting water-wheel governor has been ordered. This outfit is to be installed in the Kosaka mine in Japan. Takata & Company have also placed orders for the following apparatus to be installed in the Kokura Electric Light Company's plant: A Westinghouse, 75-kw, 2,200-volt, 60 cycle, single-phase, belted, revolving armature generator, to be driven by a Westinghouse automatic, compound engine 13 x 22 x 13, operating at 290 r.p.m. There will be a 2-kw, 125-volt, compound, direct-current generator supplied as an exciter, and also a standard Westinghouse, 2,200-volt, single-phase generator panel. The order also calls for integrating wattmeters and transformers. For use with this engine a 6-in. Hine eliminator has been ordered from the Nason Manufacturing Company. Takata & Company have also placed an order for the following apparatus to be installed in the Otani mine in Japan: A 60-kw, two-phase, 2,200-volt, 900 r.p.m., revolving armature, Westinghouse generator, together with a 2-kw exciter; a standard Westinghouse switchboard for control of the above generator and exciter; one 20-hp, one 30-hp, two 10-hp and two 15-hp, type "C," two-phase, 200-volt motors. The Kobu Railway Company, of Japan, has awarded a contract for the new electric motor car equipments to Takata & Company. This covers 16 Brill motor car trucks, with vestibule cars 30 feet in length over all, the weight of car body when empty being estimated at about 10,000 pounds. These trucks are to be supplied with Westinghouse motor equipments of the multiple-unit control system, each consisting of two direct-current railway motors, and two controllers arranged to control a train consisting of three motor cars as a multiple unit arranged for series-parallel operation. Each equipment is to be furnished with two trolleys for a double system. The length of the proposed railroad between terminals is 5¼ miles of double track, there being 10 intermediate stops, and the estimated time required for each intermediate stop is 30 seconds. The main e.m.f. of the line will be 600 volts. The contract for the air-brake equipment has not yet been let.

"COMMERCIAL MEXICO IN 1905."—In a pamphlet just issued by the Department of Labor and Commerce, through the Bureau of Statistics, under the above title, some interesting facts are given regarding the present commercial conditions in Mexico. It says: "The rapid growth of the production, industries and commerce of Mexico in recent years and the prospect for continuation of that growth is suggested by the fact that in the short period of twenty years its revenue has increased from $10,000,000 to $30,000,000, its imports from $20,000,000 to $75,000,000, and its exports from $7,000,000 to $43,000,000, exclusive of $40,500,000 of gold and silver. The investment of American capital in Mexico was estimated by United States Consul-General Barlow in 1902 at $500,000,000, nearly all invested within the last twenty-five years, and about one-half of it within the last five years. Since then the investment has doubtless increased materially. Such investments, by adding to the productive power of the land, must necessarily increase its purchasing power. Evidently, therefore, Mexico is now, and is destined to be to an increasing degree, a customer whose wants and whose resources are eminently worthy of accurate study by American business men."

CUT IN COPPER PRICES.—The United Metals Selling Company has made a reduction of ⅛ c. per lb. in the prices of refined copper, which is the first change that has been made for several months. Lake is now 15¼c. and electrolytic 15⅛c. John Stanton, the copper authority, says in regard to the reduction: "With the opening of navigation on the lakes, it is customary to make a little reduction in the price of the metal, because the freight is less for lake than for all-rail shipments. There is a saving in the lake rate of 20 cents per hundred pounds, and the producers are willing to give the trade the benefit of at least a portion of this amount. While the price is a little less, the profit to the producer is just the same. Besides, this is the time of year when large buyers of copper, both here and abroad, hold off in anticipation of placing large orders later on. We have no copper for sale now at any price, and I do not believe that any of the other large producers have very much for sale at the present time."

GENERAL ELECTRIC APPARATUS FOR CUBA.—It is stated that the General Electric Company has secured the contract for supplying all of the electrical machinery necessary for the equipment of the plant of the Compania Electrica de Santiago, of Santiago de Cuba. The company was recently organized with a capital stock of $300,000 and an authorized bond issue of $300,000 additional. The company operates under a concession given by the president and secretary of the government of the republic and a charter granted by the municipality of Santiago de Cuba. It proposes to build immediately a plant to supply light and power to private consumers and later to construct a street and suburban railway.

CARRIAGE CALL CONTRACTS.—The new talking sign manufactured by the Electric Carriage Call Company has been such a success that it has just closed contracts with Messrs. Hahne & Company, of Newark, N. J., for a sign consisting of 32 monograms; with the Hamburg-American Line for a new sign for the New York pier consisting of thirty 5 ft. monograms; with the Cahoon-Lyon Drug Company, of Buffalo, N. Y., talking sign consisting of 24 monograms, and with the Levey Cleaning Establishment, Forty-fifth Street and Broadway, for a sign consisting of 15 monograms.

GERMAN COMMERCIAL AND TECHNICAL EXPERTS.—At a recent meeting, the Chamber of Commerce for the Sonneburg District, Germany, strongly indorsed the plan of the German Government of attaching to important consulates commercial and technical experts who are to study closely the economic and trade conditions of the country to which they are sent and report thereon to the home government, which will communicate the information to general promoters, manufacturers, exporters, etc. It appears that the government has started to put this programme into execution.

CONTRACT FOR LARGE GENERATOR.—The Great Northern Power Company, through Tucker, Anthony & Co., Boston, has placed an order with the General Electric Company for a 7,500-kw generator. This order involves about $350,000. Several additional generators of a like capacity will be required as the work of construction progresses.

NEW YORK EDISON EXTENSIONS.—The New York Edison Company has filed plans for a four-story brick and stone station to be constructed at Crosby and Broome Streets, New York, at a cost of $50,000. The company has also filed plans for a two-story brick and stone extension to the station on 121st Street, at a cost of $40,000.

LARGE ORDER FOR LAMPS.—The General Electric Company has received a large order from the New Orleans Railway Company for General Electric enclosed alternating-current arc lamps. The contract calls for 3,000 of these lamps, and is one of the largest orders received at one time at the works.

BIDS FOR BOILER.—Bids for a new boiler for the Marshall (Minn.) power plant are wanted by May 13 by John R. Gray, city recorder.

lines. The annual report showed a highly satisfactory condition both financially and as to the physical properties of the corporation.

HOW TO DEVELOP SOUTH AMERICAN TRADE.—A recent communication from United States Consul Peterson at Porto Cabello, Venezuela, to the State Department gives some valuable suggestions to merchants who are trying to build up a South American trade. He points out the hindrances to the development of such trade. The first obstacle, he states, is the practice of some houses in allowing only thirty days for the payment of bills. On the other hand, European houses commonly allow six months and sometimes a year's credit. Such long credit is necessary on account of the time required to transport goods; first, to the coast towns; then, in many cases, by burros to the interior, and then to await their sale. The second drawback is stated to be the disinclination of American houses to deviate from their established system in order to meet the requirements of the South American market in the way of furnishing suitable patterns and assortments, and packing goods in convenient shape for transportation to the interior. Another point to be emphasized is the futility of seeking to make a market for goods of any kind in this part of South America by circulars and letters in English, or by commercial travelers who speak only English. The literature and correspondence introducing the articles should be in Spanish, backed by competent salesmen familiar with the language and able to impress the South American merchants favorably.

DEVELOPMENT IN MEXICO.—Sidney Sprout, general manager of the Culiacan Electric Company, backed by San Francisco capital, has closed contracts for equipment for the new electric lighting plant which is to be installed at Culiacan, Mexico. The General Electric Company will supply a 100-kw, single-phase, 2,200-volt generator, which will be direct-connected to a 150-hp Ideal tandem compound engine sold by C. C. Moore & Co., of San Francisco. Also two 150-hp Babcock & Wilcox water tube boilers. A city lighting contract calling for arc lights has been secured at the rate of $1,500 per month. The plant is to be in operation next September. The boilers are to be shipped from San Francisco by water in June and the engine and generator in July. The State of Sinaloa has ratified a 25-year exclusive telephone franchise, covering the entire State. Under its provisions this company will take over the 500 miles of long-distance telephone lines now owned by the State, installing telephone exchanges in Mazatlan and Culiacan and extending the lines. This work will be taken up as soon as the lighting plant is completed. Electric railway lines are also projected.

ALLIS-CHALMERS CONTRACTS.—The month of April is stated to be a banner month in the history of the Allis-Chalmers Company, the orders aggregating about $2,000,000. One of the large contracts was for the extension of the hydraulic and electrical equipment of the San Joaquin Power Company, of California, which included two 1,000-kw Bullock generators, with exciters, seven 350-kw transformers and other electrical machinery. Important orders were received from South Africa for mining machinery, and two orders for huge municipal pumping plants, said to be the largest single pumping engine contracts ever placed. One of the latter plants is for New Orleans, aggregating $500,000, and the other for Pittsburg, aggregating $350,000.

MOTORS FOR MACHINE DRIVE.—The activity in the application of motors to cranes, hoists and machine tools of every description is indicated by several Westinghouse orders entered during the past week as follows: The Morgan Engineering Company, of Alliance, Ohio, eight railway type crane motors with a total of 250 hp; the Pond Machine Tool Company, of Plainfield, N. J., 28 induction motors; Niles Tool Works, Cincinnati, Ohio, five direct-current motors; Long & Allstatter Company, of Hamilton, Ohio, 13 direct-current motors; the Delaware, Lackawanna & Western Railway, 26 induction motors; U. S. Hoe & Tool Company, of Columbus, Ohio, eight direct-current motors; the Austin Powder Company, ten induction motors.

THE CANADIAN WESTINGHOUSE COMPANY, LTD., has sold to the Edmonton (Alberta) Street Railway Company a 200-kw railway generator and a number of double equipments of railway motors. The city of Edmonton is the most northerly point on the American continent to operate an electric street railway. Another recent sale made by the Canadian Westinghouse Company, Limited, was that of a 500-kw, enclosed type, turbo-generator unit to the Canadian Pacific Railway Company. This unit is to be installed at Fort William on the Canadian Pacific and to be used for supplying power to the various grain elevators at that point. The unit is to operate three-phase, 600 volt, 60 cycles, 3,600 r.p.m.

TURBO-GENERATORS FOR BROOKLYN RAPID TRANSIT.—The Brooklyn Rapid Transit Company has ordered from the Westinghouse Machine Company two 7,500-kw turbo-generators in place of the previous order for one turbo-generator of 5,000 kilowatts capacity. It is understood that the Westinghouse Machine Company will furnish the turbines of the Westinghouse-Parsons

TONOPAH-GOLDFIELD TRANSMISSION.—The Owens River Water & Power Company proposes to construct a 3,000-hp plant and a 105-mile transmission line to Tonopah and Goldfield, Nev. Preliminary surveys have been completed. The probable cost of work is $350,000. W. E. Condon, San Francisco, is chief engineer.

BIDS WANTED.—Bids will be received May 31 by the Com missioners of the District of Columbia for the construction and installation of a heating, lighting and power plant, and a water supply for the Industrial Home School at Blue Plains, D. C.

THE LAMP MANUFACTURERS' ASSOCIATION will hold its meeting at Cambridge Springs, Pa., May 11, 12 and 13.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was heavy liquidation in the stock market, which was started by a further break in wheat at Chicago and its reflection in the Milwaukee defalcation, while adverse influences were also exerted by the Equitable trouble, the uncertainty regarding the relations of the transcontinental roads and the still dubious naval outlook in the East. Values in most cases reacted with some violence and the market had an unsettled temper at the close of the week. A further advance in Amalgamated Copper was based on the definite placing of its dividends on a 4 per cent basis and of stories of a pacification with the Heinze interest. This stock, however, yielded with the rest of the list, and the industrials, although the objects of a great deal of favorable talk, did not withstand the accumulated selling to which the entire market was subjected. On Saturday, after enormous liquidation during the two hours of business, with some declines extending to six or seven points, the market closed with great demoralization. Taken in connection with the previous declines of the week, many stocks are fifteen points or more below a week ago. All of the electric and traction stocks declined in sympathy with the rest of the market, General Electric suffering the heaviest decline, which was nine points. The closing quotation was 171, which was also the lowest of the week, the highest being 180¼. Allis-Chalmers common closed at 14½, being a net loss of 1⅝ points, and preferred 54, a decline of 5¼. Westinghouse common and preferred lost 4 and 3 points, respectively, the closing quotations being 170 and 190. Of the tractions Brooklyn Rapid Transit was the heaviest loser in the week's trading, the closing quotation—59¼—being a decline of 6¾ points. Metropolitan Street Railway closed at 115, which is a net loss of 5 points, and Interborough Rapid Transit closed at 202, a decline of 4 points. Electric Storage Battery touched 85, but dropped off to 81¾ and closed at 81⅞, a loss of 1⅛. American Telephone & Telegraph closed at 143, this being a net loss of 1½, and Western Union at 93. The dominant feature of the curb market was liquidation of the same character as occurred in the Stock Exchange. There were heavy declines, Northern Securities being the stock most heavily dealt in. Following are the closing quotations of May 2:

NEW YORK

	Apr. 25	May 2		Apr. 25	May 2
Allis-Chalmers Co.	15⅛	15¾	Electric Vehicle pfd.	18	18
Allis-Chalmers Co. pfd.	58	54	General Electric	178	175½
American Tel. & Cable	91	91	Hudson River Tel.	..	..
American Tel. & Tel.	143	141	Interborough Rap. Tran.	205	203¼
American Dist. Tel.	32½	32¼	Metropolitan St. Ry.	119	118¾
Brooklyn Rapid Transit	66⅜	61½	N. Y. & N. J. Tel.	..	172
Commercial Cable	..	..	Marconi Tel.	..	..
Electric Boat	35	34	Western Union Tel.	93¾	93
Electric Boat pfd.	75	74	Westinghouse com.	172½	*172½
Electric Lead Reduction	..	..	Westinghouse pfd.	190	187
Electric Vehicle	12	10			

BOSTON

	Apr. 25	May 2		Apr. 25	May 2
American Tel. & Tel	144	142¼	Western Tel. & Tel. pfd.	98½	98
Cumberland Telephone	119¼	119	Mexican Telephone	1⅛	1⅛
Edison Elec. Illum.	*255	*252	New England Telephone	139¼	138½
General Electric	177½	175	Mass. Elec. Ry.	19¾	17¾
Western Tel. & Tel.	*20	18	Mass. Elec. Ry. pfd.	67⅛	65⅛

PHILADELPHIA

	Apr. 25	May 2		Apr. 25	May 2
American Railways	53½	53	Phila. Traction	..	89¾
Elec. Storage Battery	82½	80½	Phila. Electric	11½	11¼
Elec. Storage Battery pfd.	..	..	Phila. Rapid Trans.	33⅞	33¾
Elec. Co. of America	12	12			

CHICAGO

	Apr. 25	May 2		Apr. 25	May 2
Central Union Tel.	..	..	National Carbon pfd.	114	116
Chicago Edison	..	160	Metropolitan Elev. com.	21	22½
Chicago City Ry.	..	..	Union Traction	..	..
Chicago Tel. Co.	..	..	Union Traction pfd.	..	..
National Carbon	*65½	60			

* Asked.

CALIFORNIA GAS & ELECTRIC.—At the California Gas & Electric Corporation's annual meeting of stockholders, held April 24, the retiring board of directors was re-elected. The following officers were re-elected at the directors' meeting: E. J. de Sabla, Jr., president; John Martin, vice-president; C. W. Conlisk, secretary, and R. M. Hotaling, treasurer. John A. Britton remains as general manager and F. G. Baum superintendent of transmission

type and the Westinghouse Electric & Manufacturing Company will build the electric generators.

NATIONAL ELECTRIC AFFAIRS.—The First National Bank, of Milwaukee, has had assigned to it about two-thirds of the capital stock of the National Electric Company as security for loans. The bank has now taken over the control of the latter company, and John I. Beggs, Charles F. Pfister, Frederick Vogel, Jr., J. H. Van Dyke, Jr., all of whom are directors of the First National Bank, have been elected directors of the National Electric Company, replacing S. W. Watkins, president; F. G. Bigelow, chairman of the board of directors; F. C. Randall, director, vice-president and general manager, and Gordon Bigelow. Former directors A. N. McGeoch and B. T. Becker will remain on the board. John I. Beggs, president of the Milwaukee Electric Railway & Light Company, has been elected and has accepted the presidency of the National Electric Company and will direct its affairs. Mr. Beggs announces that the business of the company will be actively continued and all contracts promptly completed. The indebtedness is now being ascertained, and when it is known a meeting of the creditors will be called to consider the best plan for protecting all creditors and promoting the future welfare and progress of the company, which Mr. Beggs believes can be made successful and profitable. The association of Mr. Beggs with these interests so prominently is the best assurance of better conditions in the future. After some years in the electrical field, a period marked by conspicuous successes, Mr. Beggs is still a growing man, seeking not merely personal aggrandizement but the larger welfare of the communities in which he lives and the interests he represents. For some time he has been one of the most prominent business men in Milwaukee, and he is already becoming an important factor in the traction field in St. Louis. It may be said of him that during the past six years he has been one of the leading instrumentalities which have transformed Milwaukee from a provincial into a cosmopolitan city. Ever since his first connection with the Edison lighting interests he has made a study of electrical manufacturing, and the National interests will find judicious fostering at his hands. It is understood to be his policy to keep the factory open and going, ensuring wages and employment to a large amount of labor in Milwaukee, and it may be taken for granted that the affairs of the company will be shrewdly fostered as the result of his long experience, his business acumen and his high courage as a man of affairs. The company is to be congratulated upon its selection of a president.

UNITED RAILWAYS COMPANY OF ST. LOUIS.—As a result of the reorganization of the United Railways Company of St. Louis, April 19, by its new owner, the North American Company, the following officers and directors were elected: John I. Beggs, president, succeeding Murray Carleton; Robert McCulloch, vice-president and general manager, re-elected. Directors: John I. Beggs, succeeding A. D. Brown; James Campbell, re-elected; Robert McCulloch, re-elected; Murray Carleton, re-elected; H. S. Priest, succeeding C. H. Spencer; W. V. A. Powelson, succeeding G. L. Edwards; Geo. R. Sheldon, succeeding E. H. Conrades; W H. Thompson, succeeding C. D. Smithers; Festus J. Wade, succeeding F. E. Marshall; C. W. Wetmore, succeeding James Brown. The formal transfer of the traction property to the North American Company took place at the meeting of the United Railways directors and the interests of the North American Company. Immediately afterward the reorganization was begun and accomplished in a few minutes. It is stated that no further changes may be expected and that all of the holdings of Brown Brothers, of New York, have been turned over to the North American Company. Brown Brothers, April 19, paid $50 additional on their subscription, which makes the total payment $113. The new $12,700,000 stock issue of the North American will increase the capitalization to $29,700,000. Practically all of the new stock is to cover the St. Louis properties acquired by the company.

AMERICAN SMELTING.—Details of the financing by which the Guggenheim Exploration Company properties and several others have been taken over by the American Smelting & Refining Company, in which the Guggenheims have a controlling interest, have been given out in an announcement by Kuhn, Loeb & Co., who have bought $25,000,000 of the 5 per cent cumulative preferred stock, series "B," of the American Smelters' Securities Company, guaranteed by the American Smelting & Refining Company. The new issue is a part of the $30,000,000 preferred stock of the American Smelters' Securities, by which title the American Smelters' Exploration Company, recently formed to take over the properties of the Guggenheim Exploration Company, will be known. The company has, in addition to the $30,000,000 preferred, $47,000,000 common stock, in which is lodged for two years, and as long thereafter as the dividend is maintained on the preferred, the voting power. A majority of the common stock is owned by the American Smelting & Refining Company. The preferred stock is guaranteed, as to par value, in liquidation by the American Smelting & Refining, and is redeemable after June 1, 1930, at the option of the Securities Company. The American Smelting & Refining Company has also agreed not to issue any bonds or to guarantee any stock or bonds or other obligations of any corporation which will involve, including the liability on the Smelters' Securities preferred stock, an actual or contingent liability of over 25 per cent of its net earnings for the twelve months preceding the issuance of such obligations.

DEVELOPMENT IN INDIA.—Considerable activity is being shown in India in electrical development. The Indian Electric Supply & Traction Company (Limited), with a capital of £600,000, divided into 120,000 shares of £5 each, announces the issue in London of 1,000 shares and £125,000 six per cent construction debenture stock, at par. One thousand shares and £25,000 of the debenture stock are offered for subscription. This company has been formed to establish and work electrical enterprises in India. Messrs. Kilburn & Co. and Crompton & Co. (Limited) occupied practically the same respective positions towards the Calcutta Electric Supply Corporation (Limited), as they will occupy toward this company. The first business of the company will be to construct a tramway in Cawnpore and its suburbs, with the necessary generating station to supply electric power for working such tramway, and also to supply current for electric light and the working of fans and for other purposes in Cawnpore. Concessions have been granted by the Municipal Board of Cawnpore, the District Board of Cawnpore and the Cantonment Committee of Cawnpore, these concessions being authorized by the government of the United Provinces of Agra and Oudh by orders which have been sanctioned by the government of India. The concessions provide for their early transfer to this company.

CONSOLIDATION AT YORK, PA.—Plans have just been completed for the reorganization and expansion of the York Street Railway and the York Traction Company, of York, Pa. The project will involve an investment in excess of $5,000,000. The plans have been under consideration for the past year, but were not matured until a few days ago. All the rural lines and city lines will be incorporated under one head with a capital sufficient to permit a completion of all the proposed extensions of the rural lines at an early date. Many of these lines have been surveyed, but are uncompleted. To do this will cost approximately $3,000,000. The present electric system represents an investment of something over $2,200,000, of which sum $1,500,000 is represented in bonds, and $700,000 has been invested by local people. When the new corporation has been formed and the lines completed, there will be more than 100 miles of road under one management.

DIXON CRUCIBLE MEETING.—At the annual meeting of the stockholders of the Joseph Dixon Crucible Company the old board, consisting of Edward F. C. Young, John A. Walker, Edward L. Young, William Murray, George T. Smith, Joseph D. Bedle and George E. Long, was unanimously re-elected. The board of directors re-elected the former officers, namely, Edw. F. C. Young, president; John A. Walker, vice-president and treasurer; George E. Long, secretary. Judge Joseph D. Bedle was also re-elected as counsel. The stockholders present expressed themselves as thoroughly satisfied with the management of the company by its officers. Of the total number, 7,345 shares, there were represented 7,145 shares.

VALLEY COUNTIES POWER COMPANY.—It has been announced, through the San Francisco office of N. W. Halsey & Company, that they have closed out the entire block of $400,000 of the Valley Counties Power Company's first mortgage sinking fund bonds, purchased a short time ago from the latter company's treasury. This completes the sale of the entire authorized issue of $2,500.000 30-year 5 per cent bonds of this concern, which is a subsidiary company of the California Gas & Electric Corporation. The Valley Counties Power Company's current earnings are said to show an increase of about 100 per cent over the figures for several corresponding months of last year.

TRACTION INTERESTS IN CINCINNATI, OHIO.—The Cincinnati, Dayton & Toledo Traction Company has increased its capital stock from $5,000,000 to $5,250,000. The increase is in new preferred stock which will be sold to pay off the floating indebtedness before the road is turned over to the Elkins-Widener Leasing Company.

BERLIN ELECTRIC RAILWAYS.—The Berlin electric street railways, working 497 kilometers, last year made a net profit of £434,900, compared with £412,200 in 1903. Owing, however, to an increase in taxation, the dividend on the share capital of £5,004,120 is reduced from 8 per cent. to 7½ per cent.

COLUMBUS (OHIO) LIGHTING BONDS.—The trustees of the sinking fund, Columbus, Ohio, will receive bids until May 12 for $18,000 electric light bonds, and bonds for a water pumping and softening works, a sewage disposal works and for public improvements.

General News of the Week

The Telephone.

PHOENIX, ARIZ.—Although not ratified by the stockholders, it is announced that the Sunset Telephone, Telegraph & Electric Company has bought the property and franchise of the Gila Valley Telephone system, including 300 miles of wire running from Roosevelt through the Gila Valley to Clifton.

FULLERTON, CAL.—It is announced that the Home Telephone Company will extend its lines to Placentia, Yorba, all of the oil wells, La Habra and Orangethorpe.

NAPA, CAL.—The Napa Telephone Company will spend about $10,000 in the improvement of its lines, switchboards, etc., and change from a ten-party line to a four-party line.

CORONADO, CAL.—The Coronado City Council has received an application for a franchise for the Home Telephone on the Coronado side of the bay and the necessary ordinance was passed.

ANAHEIM, CAL.—Articles of incorporation for the Orange Home Telephone & Telegraph Company and for a similar organization at Anaheim have been filed. Capital $100,000, of which $10,000 has been subscribed. W. L. Porterfield, L. K. Parks, E. F. Dotson, W. M. Niebel and S. A. Sanderson are the directors.

SANTA ROSA, CAL.—Supervisors' Clerk Wright has been instructed to advertise the telephone franchise petitioned for by C. Bevan Oldfield, of Green Valley, and bids will be received for same up to June 7. The franchise is for the construction of rural telephone systems in Analy township and an extensive territory will be wired.

LUMPKIN, GA.—The Southern Bell Telephone & Telegraph Company is building a line between this place and Cuthbert, via Benevolence.

ROCKFORD, ILL.—The Rockford & Interurban Telephone Company, capitalized at $30,000, has been formed by Rockford men and others interested in the Home Telephone Company.

McGRAWSVILLE, IND.—The Wilson Home Telephone Company has filed articles of incorporation with the Secretary of State. Walter Stigleman, David Kessler, Darius Wilson and W. N. Dallas are directors.

FULTON, IND.—The Fulton Telephone Company has filed amended articles of incorporation reducing the number of directors from five to three. The company has decided on a number of improvements. George Rentschler is president and H. L. Becker, secretary.

ROCKWELL, IA.—The Rockwell Telephone Company will build about 75 miles of line.

FARRAGUT, IA.—The Farragut Telephone Company will soon erect a new building to be used as a central office.

MOORHEAD, IA.—The Monona Telephone Company has been granted a franchise for a telephone exchange in this city.

WATERLOO, IA.—The property franchise and all appurtenances of the United States Telegraph & Telephone Company, with exchanges in fourteen counties in Northeastern Iowa, were awarded to Thomas Casiden, of Waterloo, for $55,000, at a public sale by order of the federal court.

IOWA CITY, IA.—A receiver has been asked for the Johnson County Telephone Company, an independent organization having lines in Johnson and adjoining counties, with a capital stock of $50,000. The officers of the company are H. L. North, of Hudson, Wis., president; J. D. Gross, of Hudson, Wis.; vice-president; and A. T. Presson, of Iowa City, secretary and treasurer.

READING, KAN.—The Reading Telephone Company of this city has been incorporated with a capital of $5,000.

McGRAWSVILLE, KAN.—The Wilson Home Telephone Company of this city has been formed with capital of $500 by Horace Shinn, Ira Graham and others.

NEW CASTLE, KY.—All the Home Telephone Companies of Henry county, viz: those of New Castle, Eminence, North Pleasureville and South Pleasureville, have consolidated, and have filed articles of incorporation under the name of "The Henry County Home Telephone Company." The directors are W. S. Wilson, J. A. Crabb, L. B. Helburn, Owen Carroll, R. L. Samuel, C. C. Lattarmer and J. S. Bailey. Mr. Wilson is president, J. C. Helbrun secretary and treasurer, and Owen Carroll assistant secretary and treasurer.

ELLICOTT CITY, MD.—The Chesapeake & Potomac Telephone Company has opened a new line to Clarksville, Dayton and Highland, in Howard County. Another line is also being built toward Guilford. The same company already covers the western section of the county from an exchange at Sykesville. The Ellicott City exchange covers the rest of this county.

WALDRON, MICH.—The Litchfield Telephone Exchange has increased its capital stock to $25,000.

TRAVERSE CITY, MICH.—A farmers' mutual telephone company has been organized to furnish telephone service in Oceana County, at cost. The officers are: President, C. W. Taylor; secretary and treasurer, Lucius Slocom and others.

SAGOLA, MICH.—The Sagola Telephone Company has decided to extend its line from Sagola to the neighboring town of Channing. Connection will also be made with the Michigan long distance lines at Iron Mountain, to the south, following the Milwaukee road right-of-way.

FLINT, MICH.—A deed conveying the property of the old Michigan Telephone Company to the Michigan State Telephone Company has been filed. The property was sold under a decree of the court some months ago. A mortgage to secure $10,000,000 in gold bonds, given by the Michigan State Telephone Company to the Old Colony Trust Company, as trustee, has also been filed.

PIPESTONE, MINN.—The Enterprise Telephone Company has filed amendments to its articles of incorporation providing for nine directors, a president, vice-president and secretary and treasurer, as the governing body of the corporation. It was further stipulated that henceforth the liability shall be $20,000.

GREAT FALLS, MONT.—W. H. Crumb & Co., of Chicago, are seeking a franchise for an independent telephone exchange.

WHITE SULPHUR SPRINGS, MONT.—This city is to have a telephone exchange, this spring. For further information address Harry Sommers, of White Sulphur Springs.

HUBBELL, NEB.—The Frontier Telephone Company has been formed with $8,000 capital.

MAGNET, NEB.—The Magnet Independent Telephone Company has been incorporated with $10,000 capital.

HASTINGS, NEB.—The Hastings Independent Telephone Company has let the contract for a central exchange building.

DANBY, N. Y.—The Danby Telephone Company has been formed; capital $7,200. Incorporators: J. E. Black, Charles E. Bruce and others of Danby.

ILION, N. Y.—The proposed increase in the telephone rates has been discussed quite freely here for the past few days and several of the business men and others have already taken steps to form a local stock company and operate an exchange in the village. The trustees will be asked to grant a franchise.

CORTLAND, N. Y.—The Killawog Telephone Company has been incorporated with a capital stock of $18,000. The company will operate lines between Lisle, Broome County, and Preble, Cortland County. The directors are C. J. Tarbell, T. R. Hilt, Marvin Murkey, J. Killawog, C. A. Baker, A. C. Adams and C. A. Brooks, of Marathon, and W. S. Dickinson, N. S. Sheralein and Joseph Sheralein, of Messengerville.

BUFFALO, N. Y.—The Frontier Telephone Company has, it is announced, been sold to the Consolidated Telephone Company. The latter company is a holding company, with a capital stock of $10,000,000, and now claims to control the independent telephone business of central and western New York. The Consolidated Company also controls the Interocean Telephone Company. The Frontier Telephone Company has been in operation here for about two years, competing with the Bell Company.

HOPE, N. D.—The Union Telephone Company has increased its capital from $50,000 to $100,000.

SOURIS, N. D.—The Farmers' Mutual Telephone Company of Souris has been chartered, with a capital of $20,000. The incorporators are Olf L. Vinje, C. G. Gardner and others

CONNEAUT, OHIO.—The directors of the Conneaut Telephone Company have decided to make further extensions of the line in East Conneaut.

CHERRY VALLEY, OHIO.—The Prudential Telehone Company has been formed, with a capital of $3,000. The incorporators are H. G. Gardiner, W. W. Swelt and others.

MESOPOTAMIA, OHIO.—The Mesopotamia Telephone Company has been organized. The officers are: President, H. J. Wilcox; vice-president, T. W. Kingdom; secretary, J. A. Sealey; treasurer, Warren Bates.

SEYMAN, OHIO.—The Seyman Farmers' Telephone Company, with headquarters at Seyman, Washington county, was incorporated here with a capital stock of $19,000. The incorporators are H. Perry, James M. Kenney, L. M. Brownrigg, O. P. Haines and G. W. Hildebrand.

SANDUSKY, OHIO.—The Central Union Telephone Company has decided to spend $20,000 in Sandusky and the work of giving the system the general overhauling which it required to put it in first-class condition to provide a better service and extend its facilities is already well under way. Additional cables will be strung over and along various thoroughfares throughout the city.

CAPRON, OKLA.—The Driftwood Telephone Company, of this city, with a capital of $1000, has been incorporated by John Nelson and William Lightburn, of Capron.

WAKITA, OKLA.—A charter has been issued to the Citizens Telephone Company of Wakita, with a capital stock of $5,000. Following are the incorporators: J. S. Burchfield, president; S. A. Lively, vice-president; G. W. Guthrie, secretary; Ernest Lemon, treasurer; F. P. Singer, J. W. Francis and R. H. Allen, directors, all of Wakita.

GALVESTON, TEX.—Arrangements are in progress for the establishment of a telephone exchange at Texas City.

WEYAUWEGA, WIS.—A receiver has been asked for the Independent Consolidated Telephone Company, of which A. L. Hutchinson of Weyauwega is president. It is stated that the libilities of the company are $30,000.

MILWAUKEE, WIS.—Plans to install telephones aboard all of the lake liners as well as the large lake freighters, and to put in telephone connections at the principal docks at every large port on the Great Lakes are being considered by the Wisconsin Telephone Company, of Milwaukee.

CHEYENNE, WYO.—The Colorado-Wyoming Telephone Company has been incorporated with a capital of $30,000. The incorporators are Geo. B. Settle, J. D. Potter and others.

Electric Light and Power.

SAN FRANCISCO, CAL.—The Westinghouse Electric & Manufacturing Company has secured a contract for a 200-kw. single-phase engine-driven generator for the Alaska Electric Light & Power Company, of Juneau. The new unit will be an auxiliary to the present installation at Juneau.

SAN FRANCISCO, CAL.—The Reno Power, Light & Water Company's generating station at Reno, Nev., has met its second accident within a month. The first shutdown was attributed to obstructions getting into the pipe line and damaging the hydraulic end of the plant to the extent of several thousand dollars. A temporary supply of current for lighting was then obtained from the transmission plant of the Truckee River General Electric Company, at Floriston, Cal. The plant was started up recently, but after one day's operation broke down again from some cause. Transformers were burned out, and the damage to machinery is estimated at $7,000 this time.

DOVER, DEL.—The Consumers' Light, Heat & Power Company has been incorporated with a capital stock of $1,000,000. The incorporators are William M. Fook of Chicago; James L. Wolcott and James H. Hughes of Delaware. The Citizens' Light, Heat & Power Company, an auxiliary concern to the above, has also been incorporated with a capital stock of $300,000.

TARPON SPRINGS, FLA.—It is proposed to construct an electric light plant and ice factory, at a cost of $6,000. Address N. F. McDonald, engineer in charge.

MONROE, GA.—The citizens have voted to issue $15,000 bonds for an electric light plant. J. B. McCrary, of Senoia, is engineer.

CHICAGO, ILL.—The Citizens' Light, Heat & Power Company has been incorporated, at Dover, Del., with a capital stock of $300,000.

LOCKPORT, ILL.—Hayes Bros., of Janesville, Wis., have secured the contract for the construction of a power house for the Lockport power development for $293,492.

MASON CITY, ILL.—There is talk of constructing an electric light plant, but nothing definite has yet been done. It is stated that an election will soon be held to vote on the question.

NOKOMIS, ILL.—The Henry Electric Light & Power Company, of Nokomis, has been incorporated with a capital stock of $20,000. The incorporators are John H. Crickenberger, Fred W. Potter and Charles A. Onyan.

CHAMPAIGN, ILL.—The Trinity-Siskyou Mining Company, of Champaign, has been incorporated with a capital stock of $50,000. The object of the company is mining, furnishing electricity and manufacturing. The incorporators are Manford Savage, A. N. Talbot and S. W. Farr.

EAST ST. LOUIS, ILL.—The St. Clair Light & Power Company, of East St. Louis, has obtained a franchise from the East St. Louis City Council to erect poles and to string wires and furnish electricity in East St. Louis, provided that within a year the company constructs an electric light plant with appliances to cost not less than $50,000. C. L. Gray is president of the company and R. W. Sikking is secretary. The company was recently incorporated for a nominal sum.

ARGENTINE, KAN.—The Sante Fe Railway Company has decided to construct a power house and electric plant here for its shop and to light its yards, at a probable cost of $48,000. W. B. Storey, Topeka, is chief engineer.

BANGOR, ME.—The Emerson Lumber Company, of Bangor, Me., is planning to install an electric lighting plant at its new mill in Island Falls, the intention being to have an installation large enough to furnish street lights in the adjacent villages and to supply current to stores and residences.

WELLESLEY, MASS.—The citizens have voted to appropriate $32,000 for the constuction of an electric lighting substation. The town will purchase current from Vincent Goldthwait, of Westboro.

LYNN, MASS.—The Lynn Gas & Electric Company has applied for permission to increase the capital stock by 2300 shares at par value $100 a share. The company contemplates the immediate expenditure of about $526,700 for gas, electrical and other equipment.

CHELSEA, MASS.—The Chelsea Board of Aldermen has passed the order authorizing the installation of a new street lighting system. The order authorizes the mayor to obtain bids. The number of arc electric lights in the city will be cut down to 74, and the incandescent system will be employed.

PENTWATER, MICH.—Harry J. McDargh, Dayton, O., is preparing plans for the development of 700 horsepower under a 28-ft. head on the Pere Marquette River for the Oceanic Electric Light & Power Company, Pentwater.

JACKSON, MICH.—The Commonwealth Power Company is reported to have awarded contracts as follows for its power plant on Kalamazoo River: General Electric Company, Schenectady, for the generating equipment, and to Henry Vanderhorst, of Kalamazoo, for the boilers.

GIBBON, MINN.—This town is considering the construction of an electric light plant.

STARKVILLE, MISS.—It has been voted to issue $8,000 bonds to improve the water works and electric plant. T. M. Cummings is city clerk.

LAUREL, MISS.—The Laurel Improvement Company has accepted the franchise offered by the city and will begin at once the construction of a light and power plant, at a cost of $25,000.

MONTROSE, MISS.—The Montrose Lumber Company will ask for a charter with a capital of $25,000 to construct electric light plant and water works among other enterprises. Incorporators: John O. Gusham, W. P. Hutto and others.

GRAND ISLAND, NEB.—The citizens have voted to construct an electric light plant, to cost not more than $35,000. It is proposed to vote on bonds later, which action will determine the matter. C. A. Baldwin is city engineer.

PATERSON, N. J.—The Paterson Electric Light, Heat & Power Company has been incorporated with a capital stock of $500,000. The incorporators are Peter S. Van Kirk, Angelo H. Knapp, Thomas J. Arnold, Mangold H. Ellenbogen, Robert Gaede, Walter Bamford and Joseph Bamford.

MALONE, N. Y.—The Malone Light & Power Company has under consideration the installing of a complete duplicate plant.

NIAGARA FALLS, N. Y.—The Archbold-Brady Co., of Syracuse, has secured the contract for the manufacture and erection of 400 49-ft. steel towers for the double transmission line between Niagara Falls and Lockport.

MALONE, N. Y.—The Malone Light & Power Company has under consideration a proposition for installing a complete duplicate plant at its works one mile north of here. The present plant is on the west side of the river, and the new one will be on the east side, directly opposite. Plans are now being made for the new equipment, and bids have been asked for machinery and supplies.

BROOKLYN, N. Y.—The following are the bids opened on April 24 by C. B. J. Snyder, Supt. School Buildings, New York City, for installing electric equipment in the Commercial High School, Brooklyn Borough: Peet, McAnerney & Powers, $30,340; W. M. Sheehan & Co., $33,239; Fredk. Pearce Co., $36,851; Reis & O'Donovan, $33,940; and Commercial Construction Co., New York City, $29,628. The contract was awarded to the last named company.

CONCORD, N. H.—At a meeting of the stockholders of the Concord Electric Company in this city, it was voted to increase the preferred stock of the company by a new issue of $50,000. The proceeds will be used for perfecting the company's plant at Sewall's Falls.

GREENSBORO, N. C.—The Greensboro Electric Co. will expend about $150,000 in the enlargement of the present plant. R. H. Gamwell is the engineer.

FAYETTEVILLE, N. C.—The Cape Fear Electric Power Company has offered to buy the city electric light plant and all other appliances, subject to a mortgage of $15,000 in bonds running from 1902 to 1932. To meet them, the company guarantees to pay $750 interest annually, and to set aside such a sinking fund as will meet the bonds at maturity. The company engages to furnish 51 arc lights of 1,200 candle power, the city having the option of increasing this number when desired.

NEWARK, OHIO.—Bids for the purchase of $15,000 bonds will be received May 25 to be used to rebuild the electric light plant.

LOVELAND, OHIO.—The Loveland Citizens' Electric Company has been incorporated with $100,000 capital stock by H. C. Hubbell, C. B. Vandervort, Joseph Baeth, H. S. Tunneson and H. C. Ramsey.

URBANA, OHIO.—The Urbana Light Company has been incorporated with a capital stock of $100,000. The incorporators are C. H. Marvin, T. H. Edmondson, J. C. Powers, A. F. Vance and Paul C. Martin.

CLEVELAND, OHIO.—The People's Electric Lighting & Power Company has been incorporated with a capital stock of $10,000. The incorporators are H. I. Emerson, N. C. D. McBride, D. F. Crane, William Brodie and George Pfultzgraff.

COLUMBUS, OHIO.—President Pond of the board of public service has announced that when the present construction work on the new city light plant is through with, the machinery and material of the old plant, that was not made use of in the new, will be auctioned off to the highest bidder.

PHILLIPSBURG, PA.—The Phillipsburg Electric Light Company will spend $40,000 in making improvements. New engines and new machinery have been ordered. These will be placed in the power house of the Centre & Clearfield Street Railway Company, whose large boilers will be utilized to furnish the power. The company proposes, also, to furnish the power for lighting Osceola.

HARRIMAN, TENN.—H. A. Coles, of Atlanta, Ga., has prepared estimates for a new electric light plant for Harriman. He estimates the cost at $40,000.

McKINNEY, TEX.—The Hunter Electrical Supply Company, of Dallas, has obtained the contract for installing a new electric light and power plant here.

GAINESVILLE, TEX.—Edward J. O'Bierne, president of the Gainesville Electric Light & Power Company, has been granted a franchise to build and operate a system of electric railways in Gainesvlle.

FINCASTLE, VA.—Doggett & Breckenridge contemplate constructing an electric light plant here. Plans have not yet been decided upon.

GREEN BAY, WIS.—Le Clair Bros., of Green Bay, have secured the contract for installing an electric light plant at the County Asylum, for about $5,000.

TALPA, MEX.—William A. Jones, of the City of Mexico, has made application to the Government of the State of Jalisco for a concession to establish an electric power and transmission plant near this place.

SAN MIGUEL ALLENDE, MEX.—An electric power plant will be installed at the Atotonilco waterfall, situated ten miles from San Miguel de Allende. The electrical energy will be transmitted to San Miguel de Allende for lighting and power purposes.

CITY OF MEXICO, MEX.—At the recent annual meeting of the stockholders of the San Ildefonso Hydraulic-Electric Company, held in the City of Mexico, a dividend of 7 per cent. on the preferred shares of $2,250,000 and 6 per cent. on the ordinary shares of $1,000,000 were declared.

OTTAWA, ONT.—Property owners of Ottawa will have an opportunity of voting on May 18 on the proposition for the purchase by the city of the Consumers' Electric Company's plant and lines. The amount mentioned in the measure is $500,000. The by-law was given first and second readings in the City Council, and it now requires the assent of the property owners before the final vote can be taken and effect given to the proposition.

The Electric Railway.

MONTGOMERY, ALA.—The Montgomery Traction Company has given a $2,000,000 mortgage to secure a loan from the Real Estate & Trust Company of Philadelphia, the money to be used in overhauling the electric system and adding thereto.

WILMINGTON, DEL.—The Pennsylvania end of the West Chester, Kennett & Wilmington Electric Railway Company, which is insolvent, was sold at Kennett Square April 20, by order of the United States Court. It was purchased by the bondholders. The price paid for the property was $200,000.

GAINESVILLE, GA.—The Gainesville, Dahlonega & Northern Railway Company has been granted a charter by the Secretary of State. The capital stock is $500,000, and the incorporators are A. J. Warner, W. A. Carlisle, W. H. Slack, F. P. Catchings and H. H. Dean of Gainesville, and J. F. Moore, W. A. Charters, H. D. Gurley, O. J. Lilly and R. H. Baker, of Lumpkin County.

GAINESVILLE, GA.—The Gainesville Electric Railway Company, which is to build an electric railway 8 miles in length, partly in Gainesville and partly outside of the city, has been incorporated with a capital stock of $300,000. The incorporators are A. J. Warner, W. H. Slack, F. P. Catchings, Z. T. Castleberry, J. W. Smith, E. S. Copeland and H. H. Dean, of Wall County, and J. F. Moore, of Lumpkin, and C. M. Merrick, of New Briton, Pa.

BOISE, IDAHO.—Promoters of Portland, Ore., have been urged by prominent citizens of Northern Idaho to assist financially in a project for the construction of an electric railway between Grangeville and Lewiston, and everything looks favorable for a consummation of the enterprise. It is proposed that business men of Grangeville and Lewiston raise $500,000 toward the completion of the project.

CHICAGO, ILL.—After long negotiations the Chicago, Milwaukee & St. Paul Railroad Company and the Northwestern Elevated Company, of Chicago, have entered into an "operating agreement" for a term of fifty years regarding the St. Paul's line running north from Wilson Avenue, Chicago, through Edgewater, Rogers Park and Evanston, to Llewellyn Park. The Northwestern Elevated will operate all passenger and freight trains north of Wilson Avenue, using electricity as motive power. The work of electrifying the St. Paul will be begun immediately by the Northwestern Company. The cost of this work is estimated at about $1,000,000. The net profits of the line north of Wilson Avenue will be divided equally between the Northwestern and St. Paul Companies.

INDIANAPOLIS, IND.—The Indianapolis & Martinsville Rapid Transit Company will extend its line from Martinsville to Bloomington. No contracts have yet been let, but it is understood the project has received the requisite financial support.

EVANSVILLE, IND.—The Evansville & Mt. Vernon Electric Railway Company has filed articles of incorporation with the County Recorder. The capital stock is placed at $10,000. Fred P. Leonard, William M. Ford, J. M. Funk and F. P. Reitz are directors.

CONNERSVILLE, IND.—The Valley Traction Company, headed by F. M. Barrows and other local capitalists, proposes to build a line from Connersville to Brookville. A franchise has been asked for in each city. A company headed by J. E. Jeffries proposes to build a local street railway in this city.

LAPORTE, IND.—Judge A. B. Anderson of the United States District Court has ordered that the Chicago & South Shore Railway Company's interurban line between Laporte and Michigan City, including al property rights and franchises, be sold at receiver's sale in Laporte, May 26. The company passed into a receiver's hands a year ago as a result of foreclosure proceedings by the Royal Trust Company of Chicago, trustees for $382,000 worth of bonds.

OTTUMWA, IA.—J. E. Houghland, promoter and secretary of the Eldon & St. Louis Railway Company, which was organized in Iowa in 1901, announces that an electric railway will be constructed from Ottumwa to Jefferson City, Mo., in the near future by Chicago capitalists.

IOWA FALLS, IA.—Representatives of the Peterson Heat, Light & Water Company, of Des Moines, who recently purchased the heating and lighting plant of this city, are considering plans for the construction of an electric interurban railway from Iowa Falls to Alden, a distance of seven miles.

PITTSBURG, KAN.—Guy Morrison Walker, of New York, has purchased for himself and F. H. Fitch, president of the Electrical Installation Company, Chicago, all the stock of the Pittsburg Railroad Company, and of the Pittsburg Light & Power Company, from the former holders, John J. Tyler and Charles S. Hinchman, of Philadelphia.

DANVILLE, KY.—The Danville Light, Power & Traction Company has organized by electing Hon. Chas. C. Fox, president. The other officers chosen were: Vice-president, Walter T. Scott, Georgetown, Ky.; secretary, treasurer and general manager, Arnold Honegger, St. Louis, Mo. Work will be commenced immediately upon an up-to-date electric light plant for the city. After this plant has been completed, a street car line will be built at this place.

LEWISTON, ME.—A company has been formed here to build an electric railway from Lewiston to Portland. The length of the line will be 30 miles. The capital stock of the company is $50,000, and the directors are Winfield S. Libby, Harry M. Dingley, Julius E. Parkhurst, J. Frank Boothby and John H. Morrill, all of Lewiston.

BANGOR, ME.—All the formalities and practical changes which were made necessary by the reorganization of the Public Works and other electric companies have now been completed and the Bangor Railway & Electric Company is now in operation. The incorporators are: President and general manager, John R. Graham; vice-president, Frank Silliman, Jr.; treasurer, F. D. Oliver; engineer, C. M. Tolman.

SOUTH FRAMINGHAM, MASS.—The Boston & Worcester Street Railway Company has installed in its power station a turbine engine with a capacity of formerly done by two horizontal reciprocating engines.

FITCHBURG, MASS.—Announcement has been made of a plan on the part of the interests controlling the Fitchburg & Leominster and the Leomin- 2000 kilowatts, with a 50 per cent overload. This engine will do the work ster, Shirley & Ayer Street Railway companies, with some outside capital, to construct an electric railway over private right of way from the terminus of the present line at Ayer to Cambridge, there to connect with the tracks of the Boston Elevated Railway, over which the cars will be taken into Boston.

MINNEAPOLIS, MINN.—The Twin City Rapid Transit Company contemplates erecting a power house, 50x100 ft.

NEW YORK, N. Y.—The New York City Interborough Railway Company, which has obtained franchises for trolley roads in the Bronx, has filed with the County Clerk a certificate of an increase in its capital stock from $400,000 to $5,000,000.

WOODVILLE, N. Y.—A company has not yet been incorporated to build the proposed electric railway between Atlanta and Woodville, but will be as soon as necessary preliminary work can be done. The proposed road is not controlled by any other electric railway.

MIDDLETOWN, N. Y.—A meeting of the stockholders of the Walkhill Transit Company under the reorganization was held in this city, when the following named officers were elected: President, E. R. Sponsler; vice-president, H. B. Royce; secretary, W. H. Sponsler; treasurer, Warwick M. Ogelsby. The capital stock of the new company is $350,000 and the bonded indebtedness is the same.

SYRACUSE, N. Y.—The State Board of Railroad Commissioners has authorized the Rochester, Syracuse & Eastern Railroad Company to issue a mortgage for $7,500,000. Of this amount $2,000,000 bonds are to be issued under the authority conferred. The company is also given permission to make an increase in common stock from $1,000,000 to $3,500,000, which will make the total stock issue of the company $6,000,000.

ZANESVILLE, OHIO.—A certificate has been filed with the auditor of state to increase the capitalization of the Southeastern Ohio Railway, Light & Power Company from $10,000 to $600,000.

STEUBENVILLE, OHIO.—The county court of Brooke County has granted a franchise to the Tri-State Traction Company to build its line from Wellsburg to Follansbee, which means that the line will be extended on up the river to this city.

COLUMBUS, OHIO.—The Columbus, Delaware & Marion Railway is preparing to extend its lines from Marion to Galion, to form a portion of the connecting link of electric railway which will give a through service from Cincinnati and Columbus to Cleveland.

KENTON, OHIO.—The Sandusky & Southwestern Traction Company which went into the hands of a receiver some time ago, has been reorganized and is getting ready to complete the line from Wapakoneta to Kenton, a distance of 36 miles. The projected line from Wapakoneta to Sandusky is about 100 miles.

YORK, PA.—The York County Traction Company has decided to extend the Red Lion & Windsor line from its present terminus in the town of Windsorville to the Susquehanna River, a distance of six and one-half miles.

NEW CASTLE, PA.—The Western Pennsylvania Motor Power Company has been organized by Pittsburg men to construct an extensive system of interurban trolley lines throughout Lawrence, Butler, Mercer and Beaver Counties. The incorporators are Alexander J. Barron, William G. Doolittle, Charles E. Martin, Edward L. Allen and Ralph L. Smith.

HARRISBURG, PA.—Charters have been granted at the State Department to the following electric railway companies: Duquesne & Lincoln Place, to build four miles of line in Allegheny County from Lincoln Place to Duquesne. The capital stock is $25,000. J. C. Lange, of Pittsburg, is president. Ambridge Borough Street Railway Company, capital $9,000, to build 1½ miles of line in Ambridge. James S. Campbell is president.

PATTON, PA.—The construction of a line between Patton and Barnsboro, 12 miles of the 35 miles in contemplation, is now assured, the finances being in hand. The line will be interurban, steam-road construction. The power plant will be built at first for 600 hp. and arranged for extensions, and direct current at 550 volts will be used. W. H. Denlinger, Patton, is president, and the contractors are Tennis Bros.' Construction Company, Pittsburg, Pa.

GEORGETOWN, S. C.—Mr. M. Mouzon, of Georgetown, is interested in the promotion of a scheme to build an electric railway in this town.

COLUMBIA, S. C—The Northern and local capitalists, who recently bought the Columbia, S C,, street railway, have not negotiated for the purchase of the Columbia Water Power Company, which supplies 9,000 hp. to the street car system and to manufacturing plants. A water power of 14,000 hp. is also to be developed on the Saluda River, near Columbia.

HAMILTON, TEX.—The contract has been signed for the construction of an interurban electric railway between Hamilton and Dublin, Tex., a distance of about 35 miles. The New York Bond & Security Company is financing the enterprise.

BRYAN, TEX.—The Bryan-College Electric Right-of-Way Company has been organized for the purpose of building an interurban electric railway between Bryan and the town of College, where the State Agricultural and Mechanical College is situated. A. W. Wilkerson, of Bryan, is one of the persons interested.

KINGSTON, ONT.—For the sum of $125,000 the bondholders of the street railway offer to sell the road to the city. At present the city has no means of proving whether the road could be operated with profit as a public utility, though it might possibly be done. However, the city would not in any event pay the price asked.

RICHMOND, CAL.—The East Shore & Suburban Railway Company, building an electric railway through Oakland, Alameda County, and Richmond, Contra Costa County, will operate in all 11 miles of line. Power will be secured from the Bay Counties Power Company, and will be transformed at a substation at Richmond. The officers of the company are: President, H. D. Pillsbury; vice-president and general manager, W. S. Rheem; secretary, E. A. Gow; electrical engineer, Clifton Bradley.

ROCHESTER, IND.—Subsidy elections in Rochester and Liberty townships, Fulton County, on April 27 voted $40,000 in aid of the Logansport & South Bend Traction Company. Richland Township, however, defeated the subsidy asked in that township.

SOUTH BEND, IND.—F. P. Delafield, of New York, was in this city recently to contract for power for an electric railway between Cleveland and Chicago. The line will be 500 miles long, aggregating, with the branches, 1,000 miles. George F. McCulloch is interested in the project.

LAPORTE, IND.—It is announced that the Indiana Railway Company has arranged to buy the Chicago, South Shore Electric Line between this city and Michigan City at receivers' sale, May 26. It is also announced that the purchasing company will build immediately from South Bend to Laporte, and that through cars are promised by January 1.

INDIANAPOLIS, IND.—The Fort Wayne, Bluffton & Marion Traction Company, capitalized at $550,000, filed articles of incorporation with the Secretary of State on April 27. The Muncie, Hartford & Fort Wayne Railroad was planning to build the line, but the new company has secured the right-of-way. This arouses the suspicion that the Indiana Union Traction Company is back of the new company's movement.

DES MOINES, IOWA.—A. E. Parks, of Chicago, Ill., who is promoting the electric interurban railway from Des Moines via Winterset to Creston, Iowa, is in the city now conferring with the business men and others interested in this enterprise.

WATERLOO, IOWA.—An important interurban transaction will be consummated in a few days. The two companies interested are the Waterloo, Cedar Falls & Northern Railway Company, formerly the Waterloo & Cedar Falls Rapid Transit Company, with about 60 miles of street and interurban lines, and the Mason City & Clear Lake Traction Company, with 11 miles of interurban track and four miles of street lines. The plan to consolidate also includes the project to construct a connecting link 51 miles in length from Mason City to Waverly, and a point on the Waterloo, Cedar Falls & Northern Interurban Line; the construction of an extension 20 miles in length from Summer, the present northeastern terminus of the Waterloo, Cedar Falls & Northern Company, to West Union, Ia., and the construction of a loop through Westfield, near Waterloo.

ANN ARBOR, MICH.—Work was commenced at Deerfield, May 1, on the Toledo, Ann Arbor & Detroit Electric Road, the contract having been let to Myers & Co., of Chicago. It will enter Toledo over the Toledo Interurban Electric Railroad, and Ann Arbor over the Detroit, Ypsilanti, Ann Arbor & Jackson Electric Railroad.

ANN ARBOR, MICH.—Manager Clark, of the Detroit, Ypsilanti, Ann Arbor & Jackson Electric Road, is authority for the statement that construction work has been commenced on the new line from Jackson to Lansing, and that the rails of the old Boland line which parallels his line are being taken up and will be used on this new line. In addition to this work, two other feeders are in contemplation. One is a line from Jackson to Coldwater, tapping a new district, including Hillsdale and Jonesville. The other is a continuation of the Saline branch to Adrian. Only twenty miles of new road will be required to complete this. The company also expects to make other improvements, such as doubling the capacity of the large power house and shops in Ypsilanti.

BROOKLYN, N. Y.—The Brooklyn Rapid Transit Company carried 1,500,000 passengers last Saturday and 1,300,000 Sunday. This is a record for April and in each case it is larger than the showing on any Decoration Day, which is considered the biggest day of the year, except Decoration Day of last year.

SYRACUSE, N. Y.—The contract for the overhead work of the Rochester, Syracuse & Eastern Railroad between Rochester and Lyons has been awarded to J. G. White & Co., which already has the contract for the track work. The railroad company will furnish the wire. The White Co. will also do the paving work required in the villages through which the road passes. A trainload of ties is en route to Palmyra. A double arch bridge is being built over Allen Creek near Brighton with an 80-foot span. An interesting point has come up for settlement in the courts relative to this railroad's desire to condemn property in the suburbs of Rochester. There is opposition to the railroad's condemning certain lands in the twenty-first ward. This section was recently annexed to the city, and it is claimed that an electric railway has no right to condemn within the city limits. There was a special section in the annexation bill for the benefit of the company, but the claim is made that it is unconstitutional because opposed to the general railroad act.

FOSTORIA, OHIO.—S. P. Douglas, of Toledo, has applied to the council for a franchise for the construction of an interurban line from this city to North Baltimore, through Bloomdale and Bairdstown.

GREENSBURG, PA.—It is the intention of the Westmoreland Company, now operating a trolley line between Latrobe and Derry, to extend the line west to Greenburg and east to Blairsville.

CLEARFIELD, PA.—The Tennis Brothers' Construction Company, of Pittsburg, may get the contract to build the new Curwensville-Clearfield Electric Railway. This company is now building the Northern Cambria line.

NEW CASTLE, PA.—The Western Pennsylvania Motor Power Company, composed of Pittsburg capitalists, seeks franchises to run a trolley system through Lawrence, Butler, Mercer and Beaver counties, taking in all the important towns in these counties. The incorporators are Alexander J. Barron, William G. Doolittle, Charles E. Martin, Edward L. Allen and Ralph L. Smith. It is said that connections will be made to Pittsburg.

PROVIDENCE, R. I.—An act in amendment of the charter of the Pascoag & Providence Street Railway Company was passed by the Rhode Island General Assembly on April 19. This act extends the time for completion of said road to June 1, 1907. This company was originally incorporated in January, 1903.

PROVIDENCE, R. I.—On April 11, an article incorporating the Worcester & Providence Street Railway Company was passed by the General Assembly of Rhode Island, with Horace A. Kimball, Fred L. Sayles, William H. Pendergast, Fayette E. Bartlett, Fred C. Hinds and Waldo R. Bartlett, John McLaughlin, John P. Meade, Delmont Smith and James McLaughlin as incorporators thereof, and with a capital stock of not exceeding $1,000,000 to be divided into shares of $100 each. Said railway is permitted to run in the public highways and elsewhere in the towns of North Providence, Smithfield, North Smithfield and Burrillville, and its cars to be operated by electricity or any power other than steam.

PROVIDENCE, R. I.—An act incorporating the Point Judith Railroad Company was passed by the Rhode Island General Assembly on April 18. The incorporators are Jeremiah P. Robinson, Isaac R. Robinson, Henry B. Kane, Charles J. Tucker and Frank D. Sturges. This charter permits the company to locate, construct and maintain a railroad commencing at some point in or near the present railroad station belonging to the Narragansett Pier Railroad Company in Narragansett Pier, and thence extending southerly to the extremity of Point Judith in the town of Narragansett and operating the same by steam or electricity. The capital stock is fixed at $100,000, par value $100. The company will have its office in the town of Narragansett.

PROVIDENCE, R. I.—On April 21, an act in amendment of the charter of the Western Rhode Island Railway Company was passed by the General Assembly of Rhode Island. By this amendment the company is empowered to acquire the property, rights and privileges of other roads in and out of the state and to acquire and dispose of the stocks, bonds and securities of the Providence & Danielson Railway Company or any other incorporated railway company. The capital stock of said company is fixed at $2,000,000 of $100 par value, and the said company must file its application for franchises in the streets of any town in which construction is authorized prior to July 1, 1906, and if said company shall fail to complete a main portion of its road prior to December 1, 1908, its further rights shall cease and determine.

SAN MARCOS, TEX.—Articles of incorporation have been filed for the San Marcos Valley Interurban Railway. A line will be constructed between San Marcos & Luling, about twenty-four miles. Rights of way, terminal grounds and depot sites have been secured and complete location survey has been made and all estimates necessary to the immediate letting of contracts have been made. The officers are: President, A. T. Fisher, St. Louis, Mo.; secretary, B. G. Neighbors, San Marcos, and chief engineer, G. W. Megrew, San Marcos, Tex.

New Industrial Companies.

THE NATIONAL ELECTRIC ALARM COMPANY has been formed in Philadelphia with a capital of $500,000.

THE HEINY ELECTRIC COMPANY, of New York City, has been incorporated with a capital stock of $500. The directors are P. F. J. Durand, A. P. Heiny and F. E. Durand, New York.

THE TELEGRAPH SCHOOL COMPANY, of Urichville, Ohio, has been incorporated with a capital stock of $10,000. The incorporators are Joseph Loeb, D. C. Foster, Otto Thalheimer, D. E. Binns and R. C. House.

THE UNIVERSAL ELECTRIC STORAGE BATTERY COMPANY, of Chicago, Ill., has been incorporated, at Dover, Del., with a capital stock of $500,000 to manufacture, sell and deal in storage batteries.

THE WEBER ELECTRIC COMPANY, of Rotterdam, N. Y., has been incorporated with a capital stock of $25,000. The directors are August Weber, John Weber and August Weber, Jr., of Schenectady, N. Y.

THE ELECTRIC ADDING MACHINE COMPANY, of Cleveland, Ohio, has been incorporated with a capital stock of $50,000. The incorporators of the company are W. S. Rogers, N. R. Coe, C. W. Pattison, C. C. Wise and A. W. Mayers.

THE LOWE ELECTRIC COMPANY, of New York City, has been incorporated with a capital stock of $10,000. The directors are E. A. Lowe, Murray Burtis, of North Plainfield, N. J., and W. B. Farrell, all of New York City.

THE O'BRIEN ELECTROPHONE COMPANY, of Augusta, Me., has been incorporated with a capital stock of $500,000 to manufacture electrical appliances. The president and treasurer of the company is Mr. I. L. Fairbanks, of Augusta.

THE IMPROVED CONSTRUCTION COMPANY, of Toledo, Ohio, has been incorporated with a capital stock of $5,000 to manufacture telephone supplies. The incorporators are F. Briggs, J. M. Ramsey, R. L. Gelzer, E. F. Briggs and M. W. Briggs.

THE JOHN A. STEWART ELECTRIC COMPANY, of Cincinnati, has been formed. The new company is capitalized at $50,000, and will take over the interests of John A. Stewart and others. The company will occupy quarters in the Glenn Building at Fifth and Sycamore Sts.

THE EASTERN ELECTRIC COMPANY, of Troy, N. Y., has been incorporated with a capital stock of $100,000 to do a general contracting and construction business. The directors are W. Levis Burk, William C. Colburn, Henry J. Speck, James H. Caldwell, William Connors, Cornelius V. Collins, of Troy, and E. Frank Andrews, of Saratoga Springs.

Educational.

SYRACUSE UNIVERSITY.—There is being erected for the College of Applied Science a new building in which will be placed metal and wood-working machines, foundry, hydraulic laboratory, forges, etc. This building is the gift of one of the most enterprising citizens of Syracuse, Mr. L. C. Smith, the well-known typewriter manufacturer, who erected in 1902 the main engineering hall, one of the finest buildings on the campus. The latter building is well equipped with machinery and apparatus requisite for the study of the science and practice of engineering. The courses of study are practically the same as those of the leading engineering schools of the country, and comprise civil, electrical and mechanical engineering. Buildings for the University have been recently erected at an expenditure of nearly a million dollars and half a million more is to be expended at once for additional buildings. Large expenditures have been made for apparatus for laboratories and books for departments. Facilities have been doubled, electives introduced and methods have been brought up to the latest sound educational thought. In the faculty, which numbers 201 members, are represented sixty-nine colleges and universities of Europe and America. The entire body of alumni now numbers nearly 3700.

Obituary.

MR. JOSEPH TYLER.—Edison employees all over the country will be grieved to hear of the death of Mr. Joseph Tyler, which occurred at his residence in Flatbush, L. I., on May 1. Mr. Tyler, familiarly known to his intimates as "Joe," was one of the old guards at the historic Pearl Street Station, New York City, his connection with the service dating from July, 1882. Beginning as a regulator, he soon drifted into the meter department, becoming in a short time superintendent of that branch. To him the Edison chemical meter was an open book and his advice was frequently sought by metermen from other cities. He died in harness, and the New York Edison Company, whom he faithfully served for so many years, feel his loss deeply, and his friends all over the country in meter work will realize that another pioneer has passed away.

Personal.

DR. CARY T. HUTCHINSON, consulting electrical engineer, has removed his offices to 60 Wall Street, New York.

MR. C. J. H. WOODBURY, of Boston, read a paper before the Brooklyn Institute of Arts and Sciences, April 28, entitled "The Telephone System of To-day."

MR. W. S. McGOWN, JR., has been appointed eastern sales manager of the American Brake Shoe & Foundry Company. Mr. McGown will make his headquarters at 170 Broadway, New York City.

MR. C. A. SELEY, mechanical engineer of the Rock Island & Pacific Railway, delivered a lecture April 11 before the students and professors of Purdue University, entitled "Framing of Passenger and Freight Cars."

MR. A. G. WESSLING, of the Bullock Electric Mfg. Company, has recently lectured before the electrical students of a number of Eastern and Western colleges on "Methods of Control for Variable-Speed Motors."

MR. S. SHIMIDZU, graduate in electrical engineering of Kyoto University, and recently engineer with the Shibaura Engineering Works, will spend some time in the United States in the study of American engineering methods.

MR. E. R. KNOWLES was the electrical engineer on the electric power and lighting plant of the American Type Founders Company, at Communipaw, N. J., described recently in these pages as an admirable example of individual motor drive in an industrial plant.

MR. GASTON HARBISON has assumed charge of the advertising and publicity department of the National Battery Company, of Buffalo, N. Y. Mr. Harbison for the past seven years has been employed in the sales department of the Electric Storage Battery Company, in its Cleveland, Baltimore and Philadelphia offices, during which time he has had valuable experience in the storage battery field.

MR. CHAS. B. JACOBS has opened a chemical and electrochemical laboratory at 52 Beaver Street, New York, with the object of carrying on a general consulting and industrial research business. Mr. Jacobs was graduated at the school of chemistry, Lehigh University. He was for several years connected with the General Electric Company in charge of the chemical laboratory at Schenectady, and for the past seven years has been actively engaged in experimental and development work, having been closely connected with some of the recent developments of electrochemical industries at Niagara.

MR. J. WALTER GILLETTE has resigned the management of the Schuylkill Valley Illuminating Company, the Consolidated Schuylkill Gas Company and the Montgomery & Chester Electric Railway Company, of Phoenixville, Pa., to assume the duties of general sales manager for the National Battery Company, of Buffalo, N. Y. Mr. Gillette has had a wide and varied experience of twelve years in designing, constructing and managing electric light and railway properties in the States and South America. The National Battery Company is fortunate in having secured in Mr. Gillette a gentleman of initiative Brooklyn, June 7.

MR. JESSE M. PARKER is president of the Parker Engineering Company of 18 East 42d Street, New York City, which is engineer and contractor for electrical construction and for plants in general. He was formerly connected with the construction department of the Western Electric Company and for the last five years superintendent of the electrical and mechanical department of the Thompson-Starrett Company. The company's engineer is Mr. C. A. Harsch, who has also been associated with the same corporation for five years and who has had charge of the installation of some of the largest local plants in New York.

MR. CHARLES FOSTER BANCROFT, of Boston, has recently become engaged to Miss Cornelia Herriman Dow, second daughter of Mr. Abbot Low Dow, of Brooklyn, N. Y. Mr. Bancroft is prominently identified with electric railway and lighting interests in Massachusetts, being electrical engineer of the Massachusetts Electric Companies and the Hyde Park Electric Light Company. He is also superintendent of motive power and machinery of the Boston & Northern Street Railway Company, and the Old Colony Street Railway Company, which are controlled by the Massachusetts Electric Companies. The wedding is to take place at 92 Remsen Street, Brooklyn, June 7.

Trade Publications.

STANLEY GENERATORS.—The Stanley Electric & Manufacturing Company has reprinted in Bulletin No. 143 an article contributed by Mr. David B. Rushmore to the *Engineering News*, entitled "The Design of Generators for Electric Power Transmission Work."

NATIONAL APPARATUS.—A beautifully executed pamphlet has been issued by the National Electric Company, Milwaukee, entitled "Plants and Types," which shows the various types of National apparatus, and gives views of a number of installations of such apparatus.

BRYANT GOODS.—With this title the Bryant Electric Company, Bridgeport, Conn., has issued a catalogue of its line of electrical appliances. No less than 209 pages and about 150 illustrations are necessary to cover the switches, lamps and circuit fittings made by this company.

ENGINE STOP AND SPEED LIMIT.—The Consolidated Engine Stop Company, 100 Broadway, has issued a new catalogue devoted to the Monarch engine stop and speed limit system, which is illustrated in detail. A long list of users takes up a number of pages of the pamphlet.

ELECTRO-DYNAMIC CIRCULARS.—Circular No. 11 of the Electro-Dynamic Company illustrates and lists the capacity of speed, dimensions and weight of its line of constant speed motors and generators of types "S" and "L," and similar information relating to the inter-pole motor is given in Circular No. 12.

BIJUR STORAGE BATTERY.—The General Storage Battery Company, 42 Broadway, New York, in its Bulletin No. 1, describes and illustrates a Bijur storage battery plant installed in an Adirondack camp. The battery consists of 62 cells with a capacity of 336 ampere-hours and takes the load at all hours between midnight and 5 p. m., as well as providing for shut-downs.

THE ROLFE ELECTRIC COMPANY, Rochester, N. Y., has issued a pamphlet describing various articles of its manufacture. The pamphlet includes an appendix which gives ample definitions and formulas for non-professional readers, together with a number of conversion and wire tables. The electrical appliances illustrated consist of its line of Schwarze universal bells and Rolfe fuse boxes.

THE ELECTRIC MACHINERY COMPANY, Minneapolis, Minn., in Bulletin No. 56, just at hand, illustrates and describes its line of revolving-field alternators and rotary converters. The machines shown in half-tones are a 500-kw., 60-cycle, three-phase, three-bearing belted alternator, together with details of bearings and armatures; a water-wheel type of alternator and a 250-kw. converter.

RHEOCRAT BULLETINS.—The American Electric & Controller Company has ready for distribution a list of Bulletins as follows: No. 1. Description of the "Rheocrat." No. 2. Applications of the "Rheocrat." No. 3. Electrically Operated Switches. No. 4. Automatic Starters for Induction Motors. Nos. 5 and 6. Applications of Automatic Starters. No. 7. Solenoids for Direct and Alternating Service. No. 8. Applications of Solenoids. When requested a suitable binder in which these Bulletins can be preserved will be furnished free of charge.

QUEEN APPARATUS.—The latest publications of Queen & Co., Philadelphia, are two well-illustrated circulars, one having for its subject condensers and self-induction apparatus, and the other the Queen sectional laboratory table. The latter is shown in types for the chemical and physical laboratory and in single and multiple sections. In the first mentioned circular are shown condensers from compact tenth-microfarad to sectional 10-microfarad types, and for use as standards, by students and for commercial purposes. The standards of self-induction are of the fixed and variable type; various accessories for the latter are also illustrated.

SUCTION GAS PLANTS.—The Power & Mining Machinery Company has issued a handsome pamphlet giving concise information on suction gas plants and of some complete installations made. An interesting comparison is given of the cost of fuel with different systems of power production. On the basis of 100 hp per year of 3000 hours and coal at $5 per ton, the cost of using the steam turbine is $2000 and with the simple non-condensing steam engine $3350, the corresponding figure for a suction producer and gas engine being $670. In the case of a gas engine using natural gas at 25 cents per thousand feet the figure is $975, and $5,700 for a gas engine using illuminating gas at $1 per thousand cubic feet.

ARTIFICIAL VS. MECHANICAL DRAFT.—In the discussion of artificial vs. mechanical draft, to which the B. F. Sturtevant Company, of Boston, Mass., has contributed so much in its admirable treatise entitled "Mechanical Draft," there occurs the following pertinent quotation from W. S. Hutton. "Artificial draft can be readily adjusted to effect the combustion of different kinds of fuel at different rates of combustion. It permits efficient combustion of fuel of inferior quality and enables a steady supply of steam

to be maintained, independent of climate and weather. It enables the supply of air to be properly distributed to the fuel in the furnace to effect economical combustion. The supply of air above the fuel can be readily adjusted to effect combustion of the gases evolved by the fuel, and the supply of air below the fuel can be regulated to effect the combustion of the solid portion of the fuel, and the movement of the hot gases can be readily controlled." It is stated that there is no valuable feature of the chimney that is not possessed by the fan to at least the same, and in many cases to a more marked degree. The very features which are most conducive to economy are those which are incidental to the use of a fan for draft production.

News of the Trade.

THE SUNDH ELECTRIC COMPANY has removed its offices from 141 Broadway to 44 East 23d Street, New York.

THE STANDARD MANUFACTURING COMPANY, of Bridgeport, Conn., is to manufacture a newly invented telephone device.

WILLIAM E. QUIMBY, Inc., manufacturer of the Quimby screw pumps, has removed his offices to 44 East 23d Street, New York.

THE SHULTZ BELTING COMPANY has moved its New York office from 113 Liberty Street to 111 Chambers Street, New York.

THE KEYSTONE ELECTRICAL INSTRUMENT COMPANY has moved its New York office from 15 Cortlandt Street to 51 Dey Street.

THE PITTSBURG REDUCTION COMPANY announces the removal of its Chicago store and office from 190 Monroe Street to the northwest corner of Lake and La Salle Streets.

THE STATE STENOGRAPHERS have consolidated their offices at 116 Nassau Street with the main offices at 170 Broadway, New York, the latter having been extended by the occupancy of a larger suite.

THE AMERICAN ELECTRIC & CONTROLLER COMPANY heretofore located at No. 12 Dey Street has taken offices in the Electrical Exchange Building, 136 Liberty Street, New York, where it has on exhibition a line of its specialties.

THE ELECTRIC MOTOR & EQUIPMENT COMPANY, Newark, N. J., has purchased the complete business of the Mason Monogram Company, 280 Broadway, New York, and will continue the sale of the latter company's well-known product. The entire plant will be located at Newark.

THE ELECTRIC EQUIPMENT & SUPPLY COMPANY has opened a temporary office at 3 Woodruff Place, Perth Amboy, N. J., where it will do a general contracting and supply business, and would be pleased to receive catalogues and prices of both standard goods and specialties.

THE STROMBERG-CARLSON TELEPHONE MFG. COMPANY, Rochester, N. Y., reports having recently closed contracts for switchboards for the following named places: Louisville, Ky.; New Berlin, N. Y.; Kenmore, N. D., Candor, N. Y.; Sidney, N. Y.; Kemp, Ill.; Pittsboro, N. C.; West Brownsville, Pa.; Camden, N. J.; Newburg, Ore.; Butte, Mont.; Wayland, N. Y.; Newport, Tenn.; Sanford, N. C.; Altoona, Pa.

MR. JOHN M. KLEIN, president and general manager of the John M. Klein Electrical Works, San Francisco, Cal., has disposed of all his interest in that company. The new company has been incorporated under the name of the John M. Klein Electrical Company. It will enter the electrical field as jobbers only, and will discontinue at once the contracting department which was run by the old company. Mr. Klein's new address is No. 325 Montgomery Street, San Francisco.

FACTORY ELECTRICAL EQUIPMENT.—The Herzog Art Furniture Company, of Cleveland, O., has recently ordered from Allis-Chalmers Company a 100-kw., three-phase, 60-cycle, alternating current generator. This will be belt-driven and is to furnish current for lighting and power purposes in the Herzog Company's factory. With it will be installed an exciter, switchboard and a number of motors, ranging in size from 5 hp. to 20 hp. Heretofore electrical driving apparatus has not been in use in this factory and it is believed that the change will be conducive both of economy and better general results.

JOHNS-MANVILLE COMPANY.—In consequence of the remarkable increase of its business, the H. W. Johns-Manville Co. has found it imperative to establish more branches in order to facilitate the handling of its business, and as a convenience to its customers. The new branches are in the Far West—San Francisco, Seattle, Kansas City, Los Angeles, Little Rock, and Minneapolis. With these in addition to the old branches, New York, Milwaukee, Chicago, St. Louis, Boston, Philadelphia, Pittsburg, Cleveland, New Orleans, London, Paris and Brussels, the company now has eighteen branches, covering the entire United States and Europe.

INTERNATIONAL STEAM PUMP COMPANY.—Mr. F. H. Jones, formerly manager of the Air Compressor Department of the International Steam Pump Co., will assume the duties of general sales manager and take up the organization of a comprehensive and thoroughly co-ordinated general sales department, similar to those recently organized by several of the large corporations. The International Steam Pump Co. controls Henry R. Worthington, having new and extensive works at Harrison, N. J.; the Geo. F. Blake Manufacturing Co. and the Knowles Steam Pump Works, located at East Cambridge, Mass.; the Laidlaw-Dunn-Gordon Co., whose manufacturing plant is at Cincinnati, Ohio; the Snow Steam Pump Works and the Holly Manufacturing Co., both located in Buffalo, N. Y.; the Deane Steam Pump Co., of Holyoke, Mass., and the Clayton Air Compressor Works, of Brooklyn, N. Y. These plants supply a large percentage of the pumping machinery used in this country, including water-works pumping engines, steam pumps, centrifugal pumps, vacuum pumps, air compressors, jet, surface and elevated condensers, cooling towers, feed-water heaters, marine pumping apparatus, water meters, and many other types of hydraulic and pneumatic machinery.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, S. S. Stadtler, 39 S. 10th St., Philadelphia.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. C. E. Skinner, New Haven, Conn. Next meeting, New York City, Sept. 19, 20 and 21, 1905.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings, last Friday each month.

AMERICAN RAILWAY, MECHANICAL & ELECTRICAL ASSOCIATION. Secretary, Walter Mower, 12 Woodward Avenue, Detroit, Mich.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, G. W. Tillson, Brooklyn, N. Y. Next meeting, Montreal, Can., Sept. 5, 6 and 7, 1905.

AMERICAN STREET RAILWAY ASSOCIATION. Secretary, T. C. Pennington, 2029 State Street, Chicago.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. S. Barstow, New York City and Portland, Ore.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, F. W. Drew, Milwaukee, Wis. Next meeting, Chattanooga, Tenn., May 17, 1905.

CANADIAN ELECTRICAL ASSOCIATION, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Montreal, June, 1905.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, George B. Tripp, Colorado Springs, Col.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, E. W. Poole, Bridgeport, Conn. Annual meeting in November.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

ELECTRICAL ASSOCIATION OF NORTH DAKOTA. Secretary, S. J. Fuller, Larimore, N. D.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, F. Fish, Rochester, N. Y.

ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association.) Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets second Friday of each month.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary, D. Davis, Litchfield, Ill.

INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES OF AMERICA. Secretary, Frank G. Jones, 48 West Jackson Boulevard, Chicago.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrebe, Huntingburg, Ind.

INDIANA ELECTRIC RAILWAY ASSOCIATION. Secretary, P. H. White, Indianapolis, Ind. Annual meeting, second Thursday in January, 1906. Monthly meetings, second Thursday of each month.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting Erie, Pa., Aug. 29, 30 and 31, 1905.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. M. Coleman, Louisville, Ky.

IOWA ELECTRICAL ASSOCIATION. Secretary, P. E. Bellamy, Knoxville, Ill. Next meeting, Des Moines.

IOWA TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Ia.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky.

MAINE STREET RAILWAY ASSOCIATION. Secretary, E. A. Newman, 471 Congress Street, Portland, Me.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby Street, Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRIC ASSOCIATION. Secretary, J. E. Davidson, Port Huron, Mich.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind. Next meeting, Baltimore, Md., October, 1905.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 44 Whitesboro Street, Utica, N. Y. Next meeting, Boston, July 19, 1905.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, Dudley Farrand, Newark, N. J. Next meeting Denver, and Colorado Springs, Col., June 6-11, 1905.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl Street, Boston, Mass. Meets last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 114 Liberty Street, New York.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, T. S. Lane, 536 Ellicott Square, Buffalo, N. Y. Next meeting Albany, N. J., June, 1905.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Chas. Currie, Akron, Ohio.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Hotel Victory, Put-in-Bay Island, Aug. 16, 17, and 18, 1905.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, C. J. Miller, 620 Shorb Street, Canton, Ohio. Next meeting, Toledo, Ohio, May 19 and 20, 1905.

PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. Secretary, G. P. Low, 600 Rialto Building, San Francisco, Cal. Next meeting, Portland, Ore., June 20, 1905.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 135 South Second Street, Philadelphia, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meetings second Saturday of each month.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, C. W. Hobson.

South Dakota Telephone Association. Secretary, H. B. Hartwell, Irene, S. D. Next annual convention, Sioux Falls, S. D., second Wednesday in January, 1906.

Street Railway Accountants' Association of America. Secretary, W. B. Brockway, 40 Morris Street, Yonkers, N. Y.

Street Railway Association of the State of New York. Secretary, W. W. Cole, Elmira, N. Y.

Vermont Electrical Association, Secretary, C. C. Wells, Middlebury Electric Light Company, Middlebury, Vt.

Virginia Street Railway & Electric Association. President, R. D. Apperson, 723 Main St., Lynchburg, Va.

Western Society of Engineers, Electrical Section. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago, Ill.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED APRIL 25, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

787,900. PLUG AND SPRING-JACK SWITCH; William W. Dean, Chicago, Ill. App. filed Jan. 14, 1902.

787,905. TELEGRAPHIC RELAY; Eugene Ducretet, Paris, France. App. filed Apr. 10, 1901. The relay is provided with means for obtaining great sensitiveness, and for facilitating the regulation of the principal parts.

787,929. TELEPHONE-SWITCHBOARD; Charles T. Mason, Sumter, S. C. App. filed Sept. 8, 1904.

787,930. TELEPHONE-SWITCHBOARD; Charles T. Mason, Sumter, S. C. App. filed Feb. 4, 1905.

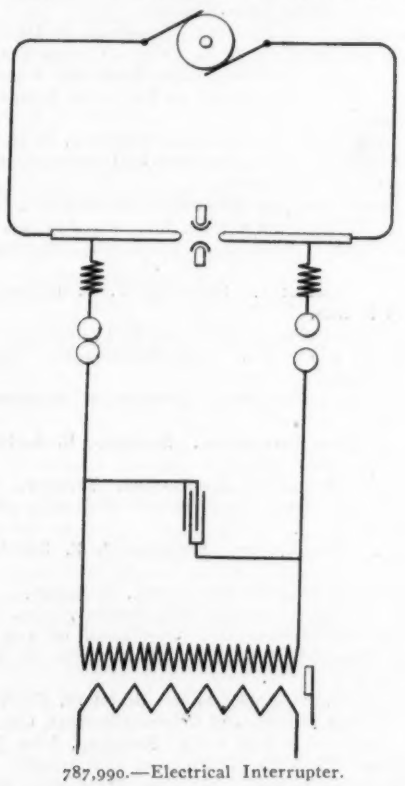
787,936. SELECTIVE SIGNALLING DEVICE; Charles H. North, Cleveland, Ohio. App. filed June 19, 1903.

787,957. ELECTRICALLY HEATED CURLING IRON; Jules Szollosy, Brighton, England. App. filed Jan. 11, 1905. An electrically heated curling iron with improved means for attaching the wire connections thereto, so as to prevent twisting or kinking of the wires.

787,967. RAILWAY SIGNAL; Asbury G. Wilson, Wilkinsburg, Pa. App. filed Feb. 3, 1905. Railway signal with means to prevent shock when the counterweight actuates the semaphore signal.

787,990. ELECTRICAL INTERRUPTER; Thomas J. Murphy, New York, N. Y. App. filed Sept. 14, 1903. Electrical interrupter for rapid interruptions in connection with powerful current at high voltage.

788,049. RECIPROCATING DEVICE FOR BRUSHES; Charles W. Johnson, Norwood, O. App. filed Aug. 4, 1903. A reciprocating device for dynamo brushes employing roller supports for the brush-yoke and means for imparting an axial movement to the supports.



787,990.—Electrical Interrupter.

788,109. ELECTRICAL PANEL BOARD; Hubert Krantz, New York, N. Y. App. filed Dec. 6, 1904. A panel board with the conductors arranged so as to occupy small space and with a comparatively small number of joints.

788,130. COMBINED CABLE-HEAD AND POLE-HOUSE; Frank B. Cook, Chicago, Ill. App. filed Dec. 28, 1903.

788,151. X-RAY METER; Tomas Proctor Hall, Chicago, Ill. App. filed Feb. 15, 1904. (See Current News and Notes.)

788,152. FIRE-ALARM AND FIRE-EXTINGUISHING APPARATUS; James Hartley, Philadelphia, Pa. App. filed July 1, 1904. A fire alarm and fire-extinguishing apparatus operating upon the fusion of its solder to ring an electric bell and allow the escape of a fire-extinguishing fluid.

788,166. ELECTRICAL SYSTEM OF HEATING; Arthur D. Newton, Hartford, Conn. App. filed July 9, 1904. A thermostatically controlled heating system for electric cars.

788,199. FIRE-ALARM; James Fiddes and John F. Watt, Aberdeen, Scotland. App. filed Jan. 23, 1905. Fire alarm employing compressed air tubing with frangible outlets, which are automatically broken on the occurrence of fire to permit the escape of compressed air, whereby an indicator is operated to close an alarm-bell circuit.

788,272. MEANS FOR OBTAINING REDRESSED CURRENTS; Luigi Magrini, Milan, Italy. App. filed Oct. 20, 1903. (See Current News and Notes.)

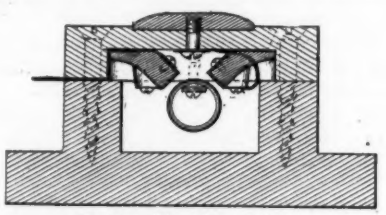
788,278. POTENTIAL REGULATOR; Edwin H. Porter and Burleigh Currier, Philadelphia, Pa. App. filed Oct. 7, 1904. Potential regulator for an alternating current dynamo which inserts a unidirectional current in the field circuit in such a manner as to add to or depress the electromotive force and current in the field circuit.

788,279. ALTERNATING-CURRENT RECTIFIER; Edwin H. Porter and Burleigh Currier, Philadelphia, Pa. App. filed Oct. 7, 1904. (See Current News and Notes.)

788,280. ELECTRIC RAILWAY; Leon W. Pullen, Philadelphia, Pa. App. filed July 18, 1904. A contact mechanism in which a magnet on the car operates a tubular armature to close the supply circuit.

788,290. PROTECTED THIRD-RAIL SYSTEM; Isaac C. Thorne, Glencove, N. Y. App. filed Jan. 2, 1904. A safety conductor adjacent to a third rail, so arranged that any contact between the two will cut out one or more sections of the system.

788,291. DYNAMO OR MOTOR; John A. Titzel, Sr., Franklin, Pa. App. filed Nov. 9, 1901. A dynamo or motor with detachable and adjustable field magnets.



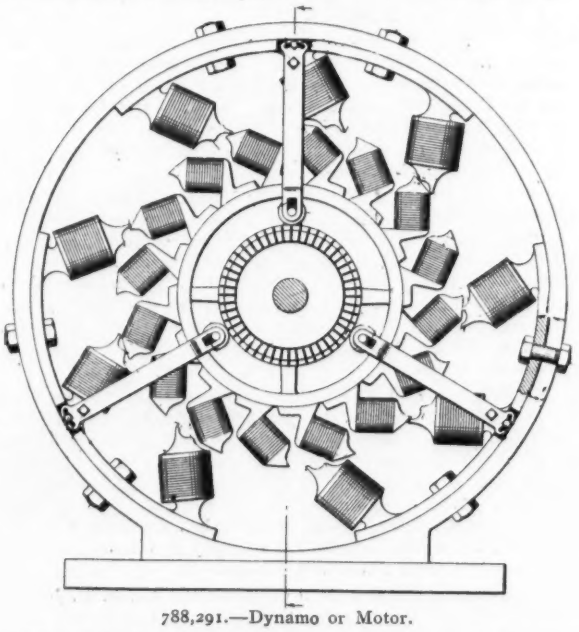
788,280.—Electric Railway.

788,329. PRESSURE CONTROLLED ELECTRIC SWITCH AND AIR GAGE; William J. Pugh, Davenport, Iowa. App. filed Aug. 20, 1904. A pressure controlled switch arranged to secure rapid and positive action and great sensitiveness.

788,365. DYNAMO ELECTRIC MACHINERY; John H. St. Hill Mawdsley, Taunton, England. App. filed Sept. 17, 1902. A special coil for a field magnet constructed to reduce magnetic leakage and the size of machine for a given output.

788,385. SIGNAL MECHANISM; James C. Waldo, Sharpsburg, Pa. App. filed Oct. 19, 1903. A railway signal for a single track with turnouts and cars running in both directions.

788,411. ELECTRIC SWITCH; Wesley D. R. MacDiarmid, Ottawa, Canada. App. filed Jan. 23, 1904. An electric switch moved to "on" and "off" positions by successive applications of pressure to a single button.



788,291.—Dynamo or Motor.

788,440. BLOCK SIGNALLING SYSTEM; Elmer G. Stuckey, Leavenworth, Kan. App. filed Dec. 13, 1904. A block signalling system embodying means for maintaining the signal in operation when a number of cars enter the block and for discontinuing the actuation of the signal when the last car leaves the block.

788,450. ELECTRIC RECIPROCATING TOOL; Paul Centner, Verviers, Belgium. App. filed Jan. 24, 1905. An electric reciprocating tool with a rectilineally reciprocating magnetic field secured without resorting to the use of a commutator.

788,452. TELEPHONE-TRANSMITTER; Henry P. Clausen, Chicago, Ill. App. filed Aug. 20, 1902.

788,473. ARMATURE; Charles W. Johnson, Norwood, and William Cooper, Cincinnati, O. App. filed July 16, 1903. An armature especially constructed to secure good ventilation.

788,477. AERIAL TELEGRAPHY; James E. King, New York, N. Y. App. filed June 23, 1903. A means for effecting an improved propagation of oscillating currents and for the tuning of circuits for the transmission of aerial messages.

788,493. INCANDESCENT ELECTRIC LAMP; Herschel C. Parker, New York, N. Y. App. filed April 5, 1904. (See Current News and Notes.)